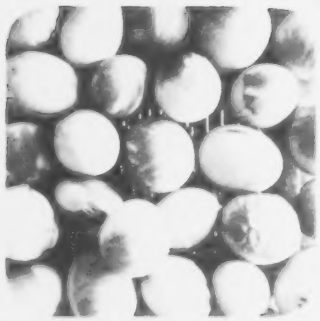

FIELD CROP PROTECTION GUIDE

2013-2015

Publication 812

Ministry of Agriculture,
Food and Rural Affairs

Ontario

Discard old editions of this publication. Each year the appropriate sub-committee of the Ontario Pest Management Research and Services Committee reviews the pesticides listed in this publication. To the best knowledge of the committee, at the time of printing, the pesticide products listed in this publication were:

- federally registered
- classified by the Ministry of the Environment (MOE)

The information in this publication is general information only. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) does not offer any warranty or guarantee, nor does it assume any liability for any crop loss, animal loss, health, safety or environmental hazard caused by the use of a pesticide mentioned in this publication.

This publication lists a number of brand names of pesticides. It is neither an endorsement of the product nor a suggestion that similar products are ineffective.

The Pesticide Label

Consult each product label before you use a pesticide. The label provides specific information on how to use the product safely, hazards, restrictions on use, compatibility with other products, the effect of environmental conditions, etc.

The pesticide product label is a legal document. It is against the law to use the product in any other way.

Federal Registration of Pesticide Products

The Pest Management Regulatory Agency (PMRA) of Health Canada registers pesticide products for use in Canada based on following an evaluation of scientific data to ensure that the product has merit and value; and the human health and environmental risks associated with its proposed use are acceptable.

1. **Full Registration**
   Pesticide registrations are normally granted for a period of five years, subject to renewal.

2. **Conditional Registration**
   Conditional registration may be granted for a specified, limited time period, where the registrant agrees to produce additional scientific or technical information, or the pesticide is used for emergency control of a serious pest outbreak.

Maximum Residue Limits

The PMRA has established maximum residue limits (MRLs) for pesticides. Processors or retailers may demand more restrictive limits. Growers should seek advice of their intended market to determine if more restrictive limitations apply. Keep accurate and up-to-date records on pesticide use in each crop.

Supplemental Labels

You MUST obtain a supplemental label and follow all the label directions when PMRA approves new uses for a registered pesticide that do not appear on the current label.

Examples of when you must use a supplemental label include:

- **Emergency Use Registration**
- **Minor Use Label Expansion**

You can obtain a copy of a supplemental label from the pesticide manufacturer or pesticide vendor, the grower association that sponsored the emergency registration or minor use, from OMAFRA or PMRA's Pest Management Information Service.

For more information on the federal registration status check the PMRA website at *www.pmra-arla.gc.ca* or call 1-800-267-6315.

Regulation of Pesticides in Ontario

The MOE is responsible for regulating pesticide sale, use, transportation, storage and disposal in Ontario. Ontario regulates pesticides by placing appropriate education, licensing and/or permit requirements on their use, under the *Pesticides Act* and Regulation 63/09.

All pesticides must be used in accordance with requirements under the *Pesticides Act* and Regulation 63/09, which are available on the e-laws website at *www.e-laws.gov.on.ca* or call ServiceOntario Publications Toll-Free number: 1-800-668-9938 or 416-326-5300.

Classification of Pesticides

The Ontario Pesticides Advisory Committee (OPAC) is responsible for reviewing and recommending to the MOE, the classification of pesticide products before they can be sold or used in Ontario. Once approved by the MOE, classified products are posted on the MOE website at *www.ene.gov.on.ca*.

Certification and Licensing

Growers and Their Assistants

For information about certification for growers and training for assistants check the Ontario Pesticide Education Program website: *www.opep.ca* or call 1-800-652-8573.

Commercial Applicators and Their Assistants

For more information about exterminator certification and licensing and technician training check the Ontario Pesticide Training & Certification website at *www.ontariopesticide.com* or call 1-888-620-9999 or 519-674-1575.

Cette publication est aussi disponible en français.

FIELD CROP PROTECTION GUIDE

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Ontario

Acknowledgements

The recommendations contained in this publication are supplied under the direction of the Field Crop Protection Subcommittee comprised of Pest and Crop Specialists of the Agriculture Development Branch, OMAFRA, University of Guelph, Ridgetown Campus, and Agriculture and Agri-Food Canada.

Need technical and business information?

Contact the Agricultural Information Contact Centre at
1-877-424-1300
or ag.info.omafra@ontario.ca

Looking for field crop production information on the Internet?

Check the OMAFRA website at
www.ontario.ca/omafra

You will find a comprehensive collection of Factsheets, articles and photos regarding the production and maintenance of field crops.

This publication contains all pesticide products and IPM strategies recommended by OMAFRA for the control of major field crop pests of Ontario. For information related to production, harvest, storage and pest life cycles, identification and other management strategies, see OMAFRA Publication 811, *Agronomy Guide for Field Crops*. Information on ordering OMAFRA publications is found on the inside back cover of this book. Publication 811 is also available on the OMAFRA website at www.ontario.ca/crops. Supplements to this publication will be posted to the OMAFRA website.

Cover Images

FRONT:	Large left:	Bean leaf beetle on a dry bean pod.
	Small left:	Western bean cutworm larva.
	Small centre:	Discolouration of soybean seed due to soybean mosaic virus.
	Small right:	Common smut in corn.
BACK:	Large left:	Spidermite infested soybean field.
	Small left:	Sudden death syndrome in soybeans.
	Small centre:	Leaf rust on wheat.
	Small right:	European corn borer inside a dry bean pod.

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Introduction

How Products Are Listed in This Book

Only products recommended for use by the Field Crop Protection Subcommittee are listed in this book.

Placement of products under each pest or disease is based on three criteria:

- efficacy (effectiveness at controlling the pest or disease)
- safety to the user
- safety to the environment
  - biological options
  - reduced risk options
  - safety to beneficials (non-target species)

Most effective products are listed first. When two products have similar efficacy against one pest or disease, the product that is lower in risk to both the environment and the applicator will appear first in the recommendation list.

Newly registered products are generally placed at the bottom of the recommendation list, unless research has proven that the product is superior to the other products already listed under that pest or disease and crop.

Within this publication where rate ranges exist, consult the product label to determine what rate is most appropriate for your pest or disease situation.

Resistance Management Strategies

Different pesticides control pests or diseases in different ways. This is called the mode of action. Pesticides are grouped into chemical families/groups based on their mode of action. Using the same pesticide with the same mode of action season after season or several times within the same season could result in the target pest/disease becoming resistant to the chemical family. A pest or disease can develop resistance to one chemical family but still be very susceptible to another. Therefore, to reduce the risk of a pest or disease developing resistance, rotate between chemical groups/families within the same season or during successive growing seasons for control of the same pest or disease. For example, if using a Group 11 fungicide (e.g., Quadris) to control rust in corn, and more than one application is required that season to manage the disease, use a product from a different group (e.g., Tilt fungicide, which is a Group 3 fungicide) for the second application, because it controls the disease using a different mode of action. Pesticide labels indicate the chemistry group or family for the product. For a list of insecticide and fungicide chemical groups, see Appendix F. *Pesticide Groups Based on Sites of Action*, on page 130.

Only use chemical control when necessary and consider implementing other forms of control such as cultural control (e.g., crop rotation, use of certified seed) or biological control to help reduce the risk of a pest or disease developing resistance to a pesticide.

Do not exceed the total number of applications allowed per year for each product. Do not apply the product at rates lower than the recommended rate on the label.

Monitor recently treated pest or disease populations for signs of resistance.

See the pesticide label for more information on resistance management. As well, for more information on resistance management strategies or integrated pest management (IPM) options for a specific pest, contact your local OMAFRA specialist or certified crop advisor. IPM options are listed in the first column of the Chemical Control Options tables in this publication.

1. Corn (Field and Seed)

CORN INSECTS

Table 1–1. Corn (Field and Seed) Seed and Soil-Applied Insecticide Recommendations

Active Ingredients	Trade Name	Formulation	Corn Insects				
			Corn Rootworm	European Chafer	Wireworms	Seedcorn Maggot	Black Cutworm
Seed Treatments							
Untreated Seed							
clothianidin	Poncho 600 at 0.25 mg ai per kernel (aka Poncho 250)	F	—	+	+	+	+
	Poncho 600 at 1.25 mg ai per kernel (aka Poncho 1250)	F	+	+	+	+	+
diazinon + captan	Agrox B-2	P (DB)	—	—	—	+	—
imidacloprid	Gaucho 480 FL	F	—	—	+	—	—
thiamethoxam	Cruiser 5 FS at 0.125–0.250 mg ai per kernel	F	—	+	+	+	—
	Cruiser 5 FS at 1.25 mg ai per kernel	F	+	+	+	+	—
Seed Pretreated With Fungicide							
diazinon + captan	Agrox CD	P (DB)	—	—	—	+	—
Soil-Applied Treatments							
chlorpyrifos	Lorsban 15 G	G	+	—	—	—	—
	Pyrifos 15 G	G	+	—	—	—	—
phorate	Thimet 15 G	G	+	—	—	—	—
tefluthrin	Force 3.0 G	G	+	—	+	+	S

DB = Drill Box Application F = Flowable G = Granular P = Powder

+ = recommended for insect listed — = NOT recommended S = suppression

CORN INSECTS

Table 1–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
CORN ROOTWORM (*Diabrotica virgifera* and *Diabrotica barberi*)				
Soil-Applied at Planting Only			**per 100-m (328-ft) row**	
Avoid planting corn following corn. Crop rotation is the best strategy for control. Risk factors include heavier soil (clay), high beetle populations in corn of previous season, and being the latest field planted in the previous season. If there is less than 1 beetle per corn plant on average throughout the month of August, then no insecticide is necessary in the following corn crop. In-furrow application is safer to the applicator and non-target animals than T-band application.	tefluthrin	Force 3 G	37.5 g	May be applied in a T-band or in-furrow. For banded applications, place directly over the furrow in a 15-cm band ahead of the press wheel. For in-furrow applications, place all material directly in the open seed furrow, behind the planter disc openers.
	chlorpyrifos	Lorsban 15 G	75 g	Must be applied in a 10–15-cm band over the row behind the planter shoe, in front of the press wheel. Do not place in direct contact with seed. 24-hr re-entry period.
		Pyrifos 15 G	75 g	
Seed Treatment			**per 80,000 kernels**	
Seed treatments are best suited for those fields at high risk of rootworm infestations, especially if planting corn after corn.	clothianidin	Poncho 1250	166.7 mL	**For use in commercial seed treatment facilities only.** For low-to-moderate rootworm populations. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure planting accuracy. A 30-day plantback interval for cereal grains, grasses, soybeans and dried beans is required.
	thiamethoxam	Cruiser 5 FS	166.7 mL	**For use in commercial seed treatment facilities only.** For low-to-moderate rootworm populations. Do not graze or feed livestock on treated areas for 45 days after planting.

* PHI = Pre-Harvest Interval (days). "—" indicates no information was provided on the product label.

CORN INSECTS

Table 1–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
Transgenic				
There are some potential cases of western corn rootworm developing resistance to Cry3Bb in the U.S. Using Bt corn products with multiple Bt traits that control corn rootworm may help to slow resistance development. To manage potential rootworm resistance, plant the appropriate refuge for the Bt corn trait used and follow all insect resistance management strategies mandated by the Canadian Food Inspection Agency. Refuge can be treated for rootworm larvae with soil-applied insecticides if thresholds prescribe it. For more information regarding Bt corn and/or refuge options, see the Canadian Corn Pest Coalition website at www.cornpest.ca. See Table 9-4.	Bt corn	Agrisure 3000GT Agrisure RW Agrisure Viptera 3111 Genuity SmartStax Genuity VT Triple Pro Herculex RW Herculex XTRA SmartStax YieldGard Plus YieldGard VT Rootworm YieldGard VT Triple	See Table 9–4, *Transgenic Crops Expressing Insecticidal or Fungicidal Traits*, on page 119, for Bt corn options.	Use Bt hybrids in fields of continuous corn with moderate-to-high populations of rootworm. Keep careful and accurate records as to where Bt and non-Bt hybrids are planted.
WIREWORMS (*Limonius* spp. and others)				
Seed Treatment			**per 80,000 kernels**	
The risk factors for wireworm infestations include fields with a history of cereal/corn/grassy weeds, sandy soils, history of wireworm problems and fields that are coming out of sod. The threshold is one wireworm per bait trap. For bait trap information, see OMAFRA Publication 811, *Agronomy Guide for Field Crops* (also available on the OMAFRA website at www.ontario.ca/crops)	clothianidin	Poncho 250	33.3 mL	**For use in commercial seed treatment facilities only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure planting accuracy. A 30-day plantback interval for cereal grains, grasses, soybeans and dried beans is required.
	imidacloprid	Gaucho 480 FL	27 mL	**For use in commercial seed treatment facilities only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
	thiamethoxam	Cruiser 5 FS	16.7 mL	**For use in commercial seed treatment facilities only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure planting accuracy. Do not graze or feed livestock on treated areas for 45 days after planting.

* PHI = Pre-Harvest Interval (days). "—" indicates no information was provided on the product label.

CORN INSECTS

Table 1–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
Soil Applied at Planting Only			**per 100-m (328-ft) row**	
In-furrow application is safer to the applicator and non-target animals than T-band application.	tefluthrin	Force 3 G	37.5 g	**In-furrow application only.** Place directly in the seed furrow behind the planter disc openers.
MILLIPEDES (Various species)				
Millipedes can be a pest in cool, wet springs in fields with heavy residue or high organic matter. They can be misidentified as wireworms. Ensure that proper identification has been made.				No registered products available at this time.
SEEDCORN MAGGOT (*Delia platura*)				
Seed Treatment			**per 100 kg seed**	
Seedcorn maggot problems in corn are extremely rare in Ontario. Use seed treatments in high-risk fields where large amounts of manure, green manure or residue have been recently incorporated, in fields that are freshly tilled or when cool, backward emergence conditions exist.	**For all seed treatments, use full rate and ensure good coverage of seed.**			
	diazinon + captan	Agrox B-2	340 g	Available as 2-kg container that will treat 600 kg of corn seed. Do not use on seed already treated with an insecticide. Seed within 1 month of treatment. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure planting accuracy.
		Agrox CD	200 g	Available as a 600-g container that will treat 300 kg of corn seed. Use this product only on seed previously treated with captan or thiram. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
			per 80,000 kernels	
	clothianidin	Poncho 250	33.3 mL	**For use in commercial seed treatment facilities only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure planting accuracy. A 30-day plantback interval for cereal grains, grasses, soybeans and dried beans is required.
	thiamethoxam	Cruiser 5 FS	16.7–33.3 mL	**For use in commercial seed treatment facilities only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure planting accuracy. Do not graze or feed livestock on treated areas for 45 days after planting.

* PHI = Pre-Harvest Interval (days). "—" indicates no information was provided on the product label.

CORN INSECTS

Table 1–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
Soil-Applied at Planting Only			**per 100-m (328-ft) row**	
In-furrow application is safer to the applicator and non-target animals than T-band application.	tefluthrin	Force 3 G	37.5 g	**In-furrow application only.** Place directly in the seed furrow behind the planter disc openers.
SEEDCORN BEETLE (*Agonoderus lecontei* and *Clivina impressifrons*)				
Risk factors for seedcorn beetle infestations include no-till, cool, wet spring, and slow crop emergence conditions.				No registered products available at this time.
BLACK CUTWORM (*Agrotis ipsilon*)				
Soil-Applied at Planting Only			**per 100-m (328-ft) row**	
Risk factors for black cutworm infestations include fields with winter annual weeds and volunteer wheat before planting, no-till fields or heavy soybean residue. Control annual weeds at least 3 weeks prior to planting to reduce attraction by adult moths flying in from the south.	tefluthrin	Force 3 G	37.5 g	Soil-applied control is not as good as a well-timed rescue treatment. May be applied as a banded or in-furrow application. For banded applications, place directly in a 15-cm band ahead of the press wheel. For in-furrow application, place all material directly in the open seed furrow, behind the planter disc openers.
Seed Treatment			**per 80,000 kernels**	
Black cutworm is a sporadic pest. Using seed treatments specifically for black cutworm control is not recommended unless the field has had a continuous history of cutworm injury.	clothianidin	Poncho 250	33.3 mL	**For use in commercial seed treatment facilities only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure planting accuracy. A 30-day plantback interval for cereal grains, grasses, soybeans and dried beans is required.
Transgenic Corn				
Use transgenic corn specifically for black cutworm control only in those fields with a history of cutworm infestations, as this pest is sporadic and may only require foliar control when thresholds are reached.	Bt corn	Agrisure Viptera 3110 Agrisure Viptera 3111 Genuity SmartStax Herculex I Herculex XTRA SmartStax	See Table 9–4, *Transgenic Crops Expressing Insecticidal or Fungicidal Traits*, on page 119, for Bt corn options.	**Use Bt hybrids containing Cry1F or Vip3A only.** May only control young larvae.

* PHI = Pre-Harvest Interval (days). "—" indicates no information was provided on the product label.

CORN INSECTS

Table 1–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
Rescue Treatments			per ha (per acre)	PHI*
Scout early. Black cutworms are easier to control when larvae are small. Look for leaf-feeding (pinholes) by young climbing larvae as the first sign of damage. If more than 10% of plants show leaf feeding, treating at this time will provide nearly 100% control.	permethrin	Ambush 500 EC	140 mL (60 mL)	— **Apply at seedling stage only.** Apply under warm, moist conditions in evening or night when cutworms are most active. Do not disturb the soil for 5 days after application.
		Pounce 384 EC	180 mL (73 mL)	—
	cypermethrin	Ripcord 400 EC	175 mL (70 mL)	21 **Apply at seedling stage only.** Apply under warm, moist conditions in evening or night when cutworms are most active. Do not disturb soil for 5 days after application.
	chlorpyrifos	Lorsban 4E	1.2–2.4 L (480–960 mL)	70 **Apply at seedling stage only.** For best results, apply in the evening. Maximum 1 application/yr. 24-hr re-entry period.
		Pyrinex 480 EC	1.2–2.4 L (480–960 mL)	—
	cyhalothrin-lambda	Matador 120 EC Silencer 120 EC	83 mL (34 mL)	14 (silage) 21 (field and seed) **Apply at seedling stage only.** Apply under warm, moist conditions in evening or night when cutworms are most active. Do not disturb soil for 5 days after application. 24-hr re-entry period.
	chlorantraniliprole	Coragen	250 mL (101 mL)	14 (field corn) 1 (seed corn) Apply to foliage when rain is not expected in the next 24 hr. Use a minimum of 100 L/ha of water. Maximum 4 applications/yr. 12-hr re-entry period.
EUROPEAN CHAFER (*Rhizotrogus majalis*)				
Seed Treatment			per 80,000 kernels	
Avoid planting corn if the grub population is extreme — plant soybeans instead. 2 or more larvae per 30 cm x 30 cm (square foot) indicate the need for control. If grub populations are high (i.e., 5 or more grubs per 30 cm x 30 cm), use the higher rate of seed treatment. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for further information on insect biology and management options.	clothianidin	Poncho 250	33.3 mL	**For use in commercial seed treatment facilities only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure planting accuracy. A 30-day plantback interval for cereal grains, grasses, soybeans and dried beans is required.
	thiamethoxam	Cruiser 5 FS	16.7 mL	**For use in commercial seed treatment facilities only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure planting accuracy. Do not graze or feed livestock on treated areas for 45 days after planting.

* PHI = Pre-Harvest Interval (days). "—" indicates no information was provided on the product label.

CORN INSECTS

Table 1–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
EUROPEAN CORN BORER (ECB) (*Ostrinia nubilalis*)				
To manage potential corn borer resistance, plant the appropriate refuge for the Bt corn trait used and follow all insect resistance management strategies mandated by the Canadian Food Inspection Agency. For more information regarding Bt corn and/or refuge options, see the Canadian Corn Pest Coalition website, found at www.cornpest.ca.	Bt corn	Agrisure 3000GT Agrisure CB Agrisure Viptera 3110 Agrisure Viptera 3111 Genuity SmartStax Genuity VT Double Pro Genuity VT Triple Pro Herculex I Herculex XTRA SmartStax YieldGard CB YieldGard Plus YieldGard VT Triple	See Table 9–4, *Transgenic Crops Expressing Insecticidal or Fungicidal Traits*, on page 119, for Bt corn options.	Insecticides have generally not provided economic control of ECB in field corn. Bt corn provides much better control. Use corn hybrids that express the Bt toxin in the ear as well as the stalk to help avoid stalk and ear rot. Keep careful and accurate records as to where Bt and non-Bt hybrids are planted.

* PHI = Pre-Harvest Interval (days). "—" indicates no information was provided on the product label.

CORN INSECTS

Table 1–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
Foliar Treatment			per ha (per acre)	PHI*	
See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, to calculate economic thresholds.	chlorantraniliprole	Coragen	250–375 mL (101–151 mL)	14 (field corn) 1 (seed corn)	Apply to foliage when rain is not expected in the next 24 hr. Time application to coincide with peak egg hatch. Use a minimum of 100 L/ha of water. Maximum 4 applications/yr. 12-hr re-entry period.
	deltamethrin	Decis 5 EC	250–300 mL (100–120 mL)	1	**Ground application only.** Apply when egg masses begin to hatch but no later than when 1st pinhole feeding occurs on foliage. For 2nd brood in late planting, apply before tassels show. Repeat in 5–8-day intervals. Use at least 240 L water/ha. Maximum 3 applications/yr. Do not feed silage or stubble to dairy cattle. 12-hr re-entry period.
	cypermethrin	Ripcord 400 EC	175 mL (70 mL)	5	Apply when egg masses begin to hatch but no later than when 1st feeding occurs on foliage. For 2nd brood in late planting, apply before tassels show. Use a minimum 300–500 L water/ha for ground application and 11–22 L/ha for aerial application. Maximum 3 applications/yr. Do not apply more than 2 applications by air. Re-entry period when foliage dries.
	cyhalothrin-lambda	Matador 120 E	187 mL (76 mL)	14 (silage) 21 (field and seed)	Ground and aerial application. For best results, apply in the early morning, before temperatures rise, or during the evening, past the heat of the day. Use 100–200 L water/ha for ground application, 10–40 L water/ha for aerial application. Spray no later than 10 days after egg hatch. Maximum 3 applications/yr. Do not apply more than 2 applications of 83 mL/ha by air. 24-hr re-entry period.
		Silencer 120 EC	83–187 mL (34–76 mL)		
	Bacillus thuringiensis	Bioprotec CAF	2.8–4.0 L (1.1–1.6 L)	1	**Ground application only.** This product is a good option for organically grown corn. Apply at first signs of infestation when larvae are small. Repeat applications, according to economic threshold, as necessary to maintain control. Use a minimum of 300 L/ha of water. This product is more effective when no rain occurs within 24–48 hr after application. Maximum 6 applications/yr.
		Dipel 2X DF	0.56–1.12 kg (0.22–0.45 kg)	1	This product is a good option for organically grown corn. Apply when pinhole feeding is observed in at least 5% of the plants. Repeat at 7-day intervals. Only effective against small larvae and must be applied before larvae begin stalk boring.
	carbaryl	Sevin XLR Plus	2.5–4.0 L (1.0–1.6 L)	1	For larvae in whorls and foliage, treat entire plant. Repeat as necessary. For silks and ears, apply in 2–4-day intervals when silks first appear. Follow label precautions applying to honeybees.

* PHI = Pre-Harvest Interval (days). "—" indicates no information was provided on the product label.

CORN INSECTS

Table 1–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
WESTERN BEAN CUTWORM (*Striacosta albicosta*)				
Transgenic Corn				
Plant the appropriate refuge for the Bt corn trait used and follow all insect resistance management strategies mandated by the Canadian Food Inspection Agency. For more information regarding Bt corn and/or refuge options, see the Canadian Corn Pest Coalition website, found at www.cornpest.ca.		Agrisure Viptera 3110 Agrisure Viptera 3111 Genuity SmartStax Herculex I Herculex XTRA SmartStax	See Table 9–4, *Transgenic Crops Expressing Insecticidal or Fungicidal Traits*, on page 119, for Bt corn options.	Bt corn hybrids containing Vip3A provide full control. Bt corn hybrids containing Cry1F provide some control. Some ear feeding may still occur and could result in ear rot (mycotoxin) development. YieldGard Bt corn varieties (Cry 1Ab) do not control western bean cutworm.
Foliar Treatment			**per ha (per acre)**	**PHI***
Use pheromone traps to monitor for pest presence and peak flight. Focus scouting efforts on the top three-to-four leaves of the plant. Look for egg masses and young larvae. Eggs hatch one or two days after turning purple. Spray is warranted if 5% of the plants have eggs or small larvae. Spray is only effective on small larvae, prior to them entering the ear. Additional impact on quality can be expected from ear rots and secondary pests that may enter and feed on the damaged ears. Additional information on pest status and management recommendations is provided at the Ontario WBC Trap Network: www.cornpest.ca/default/index.cfm/wbc-trap-network/	cyhalothrin-lambda	Matador 120 E	83–187 mL (34–76 mL)	14 (silage) 21 (field and seed)	Ground and aerial application. For best results, apply in the early morning, before temperatures rise, or during the evening. Use 100–200 L water/ha for ground application, 10–40 L water/ha for aerial application. Spray no later than 10 days after egg hatch. Maximum 3 applications/yr. Do not apply more than 2 applications of 83 mL/ha by air. 24-hr re-entry period.
	deltamethrin	Decis 5.0 EC	250–300 mL (100–120 mL)	1	**Ground application only.** Apply when egg masses begin to hatch. Use at least 240 L water/ha. Maximum 3 applications/yr. Do not feed silage or stubble to dairy cattle. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days). "—" indicates no information was provided on the product label.

CORN INSECTS

Table 1–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
ARMYWORM (TRUE – *Pseudaletia unipuncta*, FALL – *Spodoptera frugiperda*)			per ha (per acre)	PHI*
Late-planted corn is most susceptible to leaf and whorl feeding by armyworm. **True armyworm:** Insecticide may be warranted in seedling corn if there are two or more unparasitized larvae per seedling and feeding damage exceeds 10%. In corn past the 6-leaf stage, if 50% of the plants are showing damage and are infested with larvae smaller than 2.5 cm, insecticide treatment may be warranted. **Fall armyworm:** Insecticide may be warranted if 50% of the plants are infested with unparasitized larvae smaller than 2.5 cm. However, damage is usually not economical unless infestations are high, and feeding is concentrated on the undeveloped tassels. If larvae have white eggs attached to them, they are parasitized and may not need treatment. If larvae are 2.0 cm or larger, chemical control will not work well and is not recommended. Once the larvae are in the corn ear, insecticides cannot provide control.	chlorantraniliprole	Coragen	250–375 mL (101–151 mL)	14 (field corn) 1 (seed corn)	Apply to foliage when rain is not expected in the next 24 hr. Use a minimum of 100 L/ha of water. Maximum 4 applications/yr. 12-hr re-entry period.
	carbaryl	Sevin XLR Plus	2.5–4.0 L (1.0–1.6 L)	1	For larvae in whorls and foliage, treat entire plant. Repeat as necessary. Follow label precautions regarding honeybees.
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	14 (silage) 21 (field and seed)	Ground and aerial application. For best results, apply in the early morning, before temperatures rise, or during the evening. Use 100–200 L water/ha for ground application, 10–40 L water/ha for aerial application. Spray no later than 10 days after egg hatch. Maximum 3 applications/yr. Do not apply more than 2 applications of 83 mL/ha by air. 24-hr re-entry period.
		Silencer 120 EC	83 mL (34 mL)	

* PHI = Pre-Harvest Interval (days). "—" indicates no information was provided on the product label.

CORN INSECTS

Table 1–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
CORN EARWORM (CEW) (*Helicoverpa zea*)			**per ha (per acre)**	**PHI***	
Insecticides have generally not provided economic control of CEW in field corn. There may be some value in treating seed corn to maintain kernel quality. For best results, apply at or shortly after egg hatch. Target insecticides to cover the corn ear and silks.	cyhalothrin-lambda	Matador 120 E	83–187 mL (34–76 mL)	14 (silage) 21 (field and seed)	Ground and aerial application. For best results, apply in the early morning, before temperatures rise, or during the evening. Use 100–200 L water/ha for ground application, 10–40 L water/ha for aerial application. Spray no later than 10 days after egg hatch. Maximum 3 applications/yr. Do not apply more than 2 applications of 83 mL/ha by air. 24-hr re-entry period.
		Silencer 120 EC	83 mL (34 mL)		
	cypermethrin	Ripcord 400 EC	175 mL (70 mL)	5	Ground and aerial application. Ensure good coverage of ears and silks. Use minimum 300–500 L/ha of water for ground application and 11–22 L/ha for aerial application. Maximum 3 applications/yr. Do not apply more than 2 applications by air. Re-entry period when foliage dries.
	chlorantraniliprole	Coragen	250–375 mL (101–151 mL)	14 (field corn) 1 (seed corn)	Apply to foliage when rain is not expected in the next 24 hr. Use a minimum of 100 L/ha of water. Maximum 4 applications/yr. 12-hr re-entry period.
CORN FLEA BEETLE (*Chaetocnema pulicaria*)					
Seed Treatment			**per 80,000 kernels**		
Flea beetles are a vector of Stewart's bacterial wilt. It is uneconomical to spray corn with insecticides to protect against Stewart's wilt except in seed corn with highly susceptible inbreds.	clothianidin	Poncho 250	33.3 mL	**For use in commercial seed treatment facilities only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure planting accuracy. A 30-day plantback interval for cereal grains, grasses, soybeans and dried beans is required.	
	imidacloprid	Gaucho 480 FL	100 mL	**For seed corn only. For use in commercial seed treatment facilities only.** Ensure good coverage. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure planting accuracy.	
	thiamethoxam	Cruiser 5 FS	16.7–33.3 mL	**For use in commercial seed treatment facilities only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy. Do not graze or feed livestock on treated areas for 45 days after planting.	
POTATO STEM BORER (*Hydraecia micacea*)					
No insecticides are recommended or registered.					
SLUGS (Various species)					
Usually not an economic pest because growing point is not affected. Chemical control is not recommended.					

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CORN INSECTS

Table 1–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
TWO-SPOTTED SPIDERMITES (*Tetranychus urticae*)			**per ha (per acre)**	**PHI***	
Spidermites can be an economic pest in seed corn, particularly in hot, dry years. Populations can flare up shortly after applications of pyrethroid insecticides, as these insecticides control the natural enemies but have no activity on the pest.	spiromesifen	Oberon	400–600 mL (160–240 mL)	30 (field) 5 (silage)	**For use in field corn only.** Ground and aerial application. An adjuvant may be used to improve coverage and control. For best results, treatment should be made when mite populations begin to build and before a damaging population becomes established. This product is effective against the egg and nymphal stages of whiteflies and mites. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 2 applications/yr. 12-hr re-entry period.
CORN LEAF APHID (*Rhopalosiphum maidis*)			**per ha (per acre)**	**PHI***	
Aphids are rarely a problem in corn in Ontario. Spray only if populations exceed 400 aphids per plant on average.	endosulfan	Thiodan 4 EC	2.75 L (1.1 L)	50	**Ground application only.** Maximum 2 applications/yr. 48-hr re-entry period.
		Thionex EC	2.75 L (1.1 L)		
SAP BEETLES (*Glischrochilus quadrisignatus*)					
Not an economic pest but can carry *Fusarium*. Chemical control is not recommended.					

* PHI = Pre-Harvest Interval (days). "—" indicates no information was provided on the product label.

CORN DISEASES

Table 1–3. Corn (Field and Seed) Seed and Soil-Applied Fungicide Recommendations

Active Ingredients	Product	Formulation	Corn Diseases				
			Fusarium Seedling Blight	Rhizoctonia Damping-Off	Pythium Damping-Off	Aspergillus Seed Rot	Penicillium Seed Rot
Insect and Disease Control							
Untreated Seed							
diazinon + captan	Agrox B-2	P (DB)	+	—	—	+	+
Seed Pre-Treated With Fungicide							
diazinon + captan	Agrox CD	P (DB)	**For insect control only. Disease control via fungicide pretreatment.**				
Disease Control							
azoxystrobin	Dynasty 100 FS	F	—	+	+	—	—
captan	Captan Flowable	F	+	—	—	+	+
carbathiin + thiram	Vitaflo-280	F	+	+	—	—	—
fludioxonil	Maxim 480 FS	F	+	+	—	+	+
ipconazole	Vortex FL	F	+	+	—	+	+
metalaxyl	Allegiance FL	F	—	—	+	—	—
	Apron FL	F	—	—	+	—	—
metalaxyl-M	Apron XL	LS	—	—	+	—	—
trifloxystrobin	Trilex FS	F	+	—	—	—	—

DB = Drill Box Application F = Flowable LS = Liquid Suspension P= Powder

+ = Recommended for disease listed — = NOT recommended

CORN DISEASES

Table 1–4. Chemical Control Options for Diseases in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
It is recommended that all seed corn be treated with a fungicide seed treatment to prevent early-season preemergence and postemergent damping-off problems. This will help reduce seed decay and seedling blights. Corn seedling diseases are prevalent under cool wet conditions that keep the soil temperatures below 13°C. Low-lying or poorly drained areas of the field are often the first to show disease problems. Seed rots and seedling blights are more severe in no-till or reduced-tillage fields since heavy residue will keep soil temperatures cooler and wetter longer than conventional fields. Damping-off will occur in conventional fields when the crop is planted early in conditions that favour disease development or when environmental conditions cause slow germination. Other factors that delay germination and emergence, such as compaction, crusting, deep planting, etc., can also result in a poor stand. Plant vigour is often reduced in those plants that do survive.				
PYTHIUM DAMPING-OFF (*Pythium* spp.)				
Seed Treatment			**per 100 kg seed**	
This disease can occur on all soil types but losses are greatest in cold, wet clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Plant when soil temperatures are above 13°C. There is no known resistance but some degree of tolerance is available in some hybrids. Crop rotation has limited effect. Consult with your seed company and the Ontario Corn Committee Hybrid Performance Trials at www.gocorn.net for hybrid selection.	metalaxyl-M	Apron XL LS	20–40 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL	46–110 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL		
	azoxystrobin	Dynasty 100 FS	10 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Must be used in combination with Maxim XL for control of other corn diseases.
RHIZOCTONIA (*Rhizoctonia solani*)				
Seed Treatment			**per 100 kg seed**	
This disease can occur on all soil types. There are no known resistant or tolerant hybrids available. Remove excess soil moisture through improved drainage. Plant seed when soil temperatures are above 13°C.	fludioxonil	Maxim 480 FS	5.2–10.4 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting.
	carbathiin + thiram	Vitaflo 280	280 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	azoxystrobin	Dynasty 100 FS	10 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Must be used in combination with Maxim XL for control of other corn diseases.
	ipconazole	Vortex FL	5.6 mL	**For use in commercial seed treatment facilities only.** Use only in treating equipment that can accurately control application rates and provide good distribution of chemical onto seed in the mixing chamber. Not for use in hopper-box, planter-box, slurry-box or similar seed treatment applications. This product contains no dye. An appropriate seed colourant must be applied.

* PHI = Pre-Harvest Interval (days)

CORN DISEASES

Table 1–4. Chemical Control Options for Diseases in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
FUSARIUM SEEDLING BLIGHT (*F. culmorum*, *F. graminearum* and *F. avenaceum*)				
Seed Treatment			**per 100 kg seed**	
Some level of resistance or tolerance to this disease is available in some hybrids. Rotate with other crops. Tillage has little effect. Treat seed with fungicide and reduce early-season stresses. Plant when soil temperatures are above 13°C. Consult with your seed company and the Ontario Corn Committee Hybrid Performance Trials at www.gocorn.net for hybrid selection.	fludioxonil	Maxim 480 FS	5.2–10.4 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting.
	carbathiin + thiram	Vitaflo 280	280 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	captan	Captan Flowable	200 mL	Mix with the amount of water required for the slurry treater equipment to be used.
	trifloxystrobin	Trilex FS	21 mL	**For use in commercial seed treatment facilities only.** Apply using standard commercial seed treatment equipment. Not for use in hopper-box, planter-box, slurry-box or similar seed treatment applications. Uniform application on seed is necessary to ensure seed safety and best disease protection.
	ipconazole	Vortex FL	5.6 mL	**For use in commercial seed treatment facilities only.** Use only in treating equipment that can accurately control application rates and provide good distribution of chemical onto seed in the mixing chamber. Not for use in hopper-box, planter-box, slurry-box or similar seed treatment applications. This product contains no dye. An appropriate seed colourant must be applied.
ASPERGILLUS (*Aspergillus* spp.) SEED ROT				
Seed Treatment			**per 100 kg seed**	
Aspergillus seed rot is occasionally a problem in Ontario.	fludioxonil	Maxim 480 FS	5.2–10.4 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting.
	ipconazole	Vortex FL	5.6 mL	**For use in commercial seed treatment facilities only.** Use only in treating equipment that can accurately control application rates and provide good distribution of chemical onto seed in the mixing chamber. Not for use in hopper-box, planter-box, slurry-box or similar seed treatment applications. This product contains no dye. An appropriate seed colourant must be applied.

* PHI = Pre-Harvest Interval (days)

CORN DISEASES

Table 1–4. Chemical Control Options for Diseases in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
PENICILLIUM (*Penicillium oxalicum*) SEED ROT					
Seed Treatment			**per 100 kg seed**		
This disease prefers high temperatures and is found only until the nodal roots develop. Infected roots may appear blue-green.	fludioxonil	Maxim 480 FS	5.2–10.4 mL		**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting.
	ipconazole	Vortex FL	5.6 mL		**Provides suppression only. For use in commercial seed treatment facilities only.** Use only in treating equipment that can accurately control application rates and provide good distribution of chemical onto seed in the mixing chamber. Not for use in hopper-box, planter-box, slurry-box or similar seed treatment applications. This product contains no dye. An appropriate seed colourant must be applied.
RUST (*Puccinia sorghi*)			**per ha (per acre)**	**PHI***	
Rust is generally not a problem in Ontario except when infection begins early in the season. Field corn has good resistance compared to seed corn, sweet corn and specialty corn hybrids. As a result, foliar fungicides in field corn are not needed unless significant disease appears before corn tassels. Humid, cool conditions favour this disease.	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	30	Ground and aerial application. Apply when disease first appears, followed by a second application 14 days after, if environmental conditions are favourable for disease development. **Do not apply to field corn or field corn grown for seed after brown silk.** Maximum 2 applications/yr. 12-hr re-entry period.
	azoxystrobin	Quadris	453 mL (183 mL)	7	Ground and aerial application. Apply prior to disease development. Second application may be made 7–14 days later. Maximum 2 applications/yr. Do not re-enter treated area until residues have dried.
	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	7	Ground and aerial application. For optimal disease control, begin applications prior to disease development. Use a minimum water volume of 100 L/ha. Do not graze treated crop within 6 days of last application. Maximum 2 applications/yr. 12-hr re-entry period.
	propiconazole	Tilt 250 E	500 mL (200 mL)	14	Ground and aerial application. Apply when rust pustules first appear. Under severe disease pressure, a second application 14 days later may be necessary. Only in seed corn, under severe disease pressure can a third application be made 14 days later. Can be tank-mixed with Ripcord or Matador insecticide for insect control.
		Bumper 418 EC	300 mL (121 mL)		
	prothioconazole	Proline 480 SC	420 mL (170 mL)	14	**Ground application only.** Maximum 1 application/yr. 24-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

CORN DISEASES

Table 1–4. Chemical Control Options for Diseases in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
NORTHERN CORN LEAF BLIGHT (*Setospaeria turcica*)			per ha (per acre)		
Risk of this disease is on the rise in Ontario. Northern corn leaf blight is not generally a problem in field corn, since good resistance is available in hybrids. Consult with your seed company and the Ontario Corn Committee Hybrid Performance Trials at www.gocorn.net for hybrid selection. Seed corn may need protection. Crop rotation and tillage will reduce inoculum levels in surface residues. In reduced tillage systems, rotation and resistance are necessary. Chemical control is not usually economical in field corn.	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	30	Ground and aerial application. Apply when disease first appears, followed by a second application 14 days after, if environmental conditions are favourable for disease development. **Do not apply to field corn or field corn grown for seed after brown silk.** Maximum 2 applications/yr.
	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	14	Ground and aerial application. Apply when rust pustules first appear. Under severe disease pressure, a second application 14 days later may be necessary. Only in seed corn, under severe disease pressure can a third application be made 14 days later. Can be tank-mixed with Ripcord or Matador insecticide for insect control.
		Bumper 418 EC	150–300 mL (60–121 mL)		
	prothioconazole	Proline 480 SC	420 mL (170 mL)	14	**Ground application only.** Maximum 1 application/yr. 24-hr re-entry period.
HELMINTHOSPORIUM LEAF SPOT (*Cochliobolus carbonum*)			per ha (per acre)	PHI*	
This disease is not generally a problem in Ontario since hybrids with resistance are available. Consult with your seed company and the Ontario Corn Committee Hybrid Performance Trials at www.gocorn.net for hybrid selection. Crop rotation and tillage will reduce inoculum levels in surface residues. In reduced tillage systems, rotation and resistance are necessary. Chemical control is usually not economical in field corn but may be necessary if a very susceptible seed corn inbred is used.	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	14	Ground and aerial application. Apply when rust pustules first appear. Under severe disease pressure, a second application 14 days later may be necessary. Only in seed corn, under severe disease pressure can a third application be made 14 days later. Can be tank-mixed with Ripcord or Matador insecticide for insect control.
		Bumper 418 EC	150–300 mL (60–121 mL)		

* PHI = Pre-Harvest Interval (days)

CORN DISEASES

Table 1–4. Chemical Control Options for Diseases in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
EYE SPOT (*Aureobasidium zeae*)			**per ha (per acre)**		
Many resistant or tolerant commercial hybrids are available. Consult with your seed company and the Ontario Corn Committee Hybrid Performance Trials at www.gocorn.net for hybrid selection. Crop rotation and tillage will reduce inoculum levels in surface residues. In reduced tillage systems, rotation and resistance are necessary. Chemical control is usually not economical in field corn but may be necessary if a very susceptible seed corn inbred is used.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	7	Ground and aerial application. Use a minimum water volume of 100 L/ha. For optimal disease control, begin applications prior to disease development. Do not graze treated crop within 6 days of last application. Maximum 2 applications/yr. 12-hr re-entry period.
	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	30	Ground and aerial application. Apply when disease first appears, followed by a second application 14 days after, if environmental conditions are favourable for disease development. **Do not apply to field corn or field corn grown for seed after brown silk.** Maximum 2 applications/yr.
	propiconazole	Tilt 250 E	500 mL (200 mL)	14	Ground and aerial application. Apply when rust pustules first appear. Under severe disease pressure, a second application 14 days later may be necessary. Only in seed corn, under severe disease pressure can a third application be made 14 days later. Can be tank-mixed with Ripcord or Matador insecticide for insect control.
		Bumper 418 EC	300 mL (121 mL)		
	prothioconazole	Proline 480 SC	420 mL (170 mL)	14	**Ground application only.** Maximum 1 application/yr. 24-hr re-entry period.
GREY LEAF SPOT (*Cercospora zeae-maydis*)			**per ha (per acre)**	**PHI***	
This disease is becoming more common in Southwestern Ontario. Some hybrids are tolerant/resistant to the disease. Consult with your seed company and the Ontario Corn Committee Hybrid Performance Trials at www.gocorn.net for hybrid selection. Crop rotation and tillage will reduce inoculum levels in surface residues. In reduced tillage systems, rotation and resistance are necessary. Chemical control is usually not economical in field corn.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	7	Ground and aerial application. Use a minimum water volume of 100 L/ha. For optimal disease control, begin applications prior to disease development. Do not graze treated crop within 6 days of last application. Maximum 2 applications/yr. 12-hr re-entry period.
	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	30	Ground and aerial application. Apply when disease first appears, followed by a second application 14 days after, if environmental conditions are favourable for disease development. **Do not apply to field corn or field corn grown for seed after brown silk.** Maximum 2 applications/yr.
	prothioconazole	Proline 480 SC	420 mL (170 mL)	14	**Ground application only.** Maximum 1 application/yr. 24-hr re-entry period.
	propiconazole	Tilt 250 E	500 mL (200 mL)	14	Ground and aerial application. Apply when rust pustules first appear. Under severe disease pressure, a second application 14 days later may be necessary. Only in seed corn, under severe disease pressure can a third application be made 14 days later. Can be tank-mixed with Ripcord or Matador insecticide for insect control.
		Bumper 418 EC	300 mL (121 mL)		

* PHI = Pre-Harvest Interval (days)

CORN DISEASES

Table 1–4. Chemical Control Options for Diseases in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
SOUTHERN CORN LEAF BLIGHT (*Cochliobolus heterostrophus*)			per ha (per acre)	PHI*	
	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	30	Ground and aerial application. Apply when disease first appears, followed by a second application 14 days after, if environmental conditions are favourable for disease development. **Do not apply to field corn or field corn grown for seed after brown silk.** Maximum 2 applications/yr.
	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	14	Ground and aerial application. Apply when disease first appears. Can be tank-mixed with Ripcord or Matador insecticide for insect control. Under severe disease pressure, a second application 14 days later may be necessary. Only in seed corn, under severe disease pressure can a third application be made 14 days later.
		Bumper 418 EC	150–300 mL (60–121 mL)		

* PHI = Pre-Harvest Interval (days)

CORN DISEASES

Table 1–4. Chemical Control Options for Diseases in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
FUSARIUM (*Fusarium* spp.) and GIBBERELLA (*Gibberella* spp.) EAR ROTS			per ha (per acre)	PHI*	
Any of the *Fusarium* or *Gibberella* rots can establish after pollination in wounds created by insects or birds. Warm rainy weather or long dews any time after pollination may lead to ear rots in these wounded cobs. The most common and important ear mould in Ontario is *Gibberella zeae*, which is the sexual reproductive stage of *Fusarium graminearum*. Many plant pathologists believe that in years with a high occurrence of fusarium head blight in wheat, the potential exists for increased gibberella ear rot in corn. These ear rots are especially important to swine and other livestock producers since they produce mycotoxins that can have a detrimental effect on the animals. Preventing ear rots is difficult since weather conditions are critical to disease development. Although some tolerant hybrids are available, none have complete resistance. Consult with your seed company and the Ontario Corn Committee Hybrid Performance Trials at www.gocorn.net for hybrid selection. Harvest fields quickly where 10% of the ears have some ear rot to limit further disease development and potential mycotoxins production. See OMAFRA Publication 811, *Agronomy Guide for Field Crops* for more information.	prothioconazole	Proline 480 SC	420 mL (170 mL)	14	**Provides suppression only. Ground application only.** Timing of application is critical. Apply from the development stage of corn between the tip of stigmata visible (silking, BBCH 63) to the stigmata drying (silk browning, BBCH 67). This product will reduce both disease symptoms and levels of mycotoxin in the grain. Maximum 1 application/yr. 24-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

2. Soybeans

SOYBEAN INSECTS

Table 2–1. Chemical Control Options for Insects in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
SEEDCORN MAGGOT (*Delia platura*)				
Seed Treatment			**per 100 kg seed**	
Consider using insecticide seed treatments in early-planted fields where large amounts of manure, green manure or residue have been recently incorporated or when cool conditions unfavourable for emergence are expected. Expect only 60%–70% control with seed treatments applied on-farm.	**For all seed treatments use full rate and ensure good coverage of seed.**			
	diazinon + captan	Agrox B-2	340 g	Available as a 2-kg container that will treat 625 kg of soybean seed. Do not use on seed already treated with an insecticide. Seed within 1 month of treatment.
		Agrox CD	200 g	Available as a 600-g container that will treat 300 kg of soybean seed. Use this product only on seed previously treated with captan or thiram.
	thiamethoxam	Cruiser 5 FS	50–83 mL	**For use in commercial seed treatment facilities only.** Use higher rate when insect populations are expected to be high. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	**For use in commercial seed treatment facilities only.** Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
SLUGS (Various species)				
No chemical control available. Slugs often avoid contact by feeding below ground, and dew and rainfall easily wash any product used away from the slugs and leaves. Removing crop residue will help expose slugs to the elements. Tillage will also disturb their habitat and expose them to predators.				
See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for rotation and tillage recommendations.				
SOYBEAN APHID (*Aphis glycines*)				
Seed Treatment			**per 100 kg seed**	
Foliar treatment at threshold is the recommended method of control. However, seed treatments for the control of other soil insect pests may provide early-season protection (up to 40 days after planting) from early infestations of soybean aphids.	thiamethoxam	Cruiser 5 FS	83 mL	**For use in commercial seed treatment facilities only.** Provides only early-season protection against soybean aphids and will not protect crop against typical mid-to-late-season aphid infestations.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	**For use in commercial seed treatment facilities only.** Provides early-season protection. Will not protect crop against typical mid-to-late season aphid infestations. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.

* PHI = Pre-Harvest Interval (days)

SOYBEAN INSECTS

Table 2–1. Chemical Control Options for Insects in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
Foliar Treatment			per ha (per acre)	PHI*	
Foliar treatment is the recommended method of control for soybean aphids. Aphid infestations are more likely to cause yield reduction if the plants are already suffering from drought conditions or another stress factor. Scout fields frequently. Apply foliar insecticide when threshold of "250 aphids per plant with increasing populations" has been reached in the R1–R5 stage of soybeans. If aphid populations do not appear to be on the increase above 250 per plant, do not apply insecticide, as it will kill off the beneficial insects that are keeping the aphid population in check. Aphids are then likely to increase quickly in the absence of their predators and could easily reach threshold. For further information on scouting techniques, thresholds and management options, see OMAFRA Publication 811, *Agronomy Guide for Field Crops*.	cyhalothrin-lambda	Matador 120 E	83–233 mL (34–94 mL)	21	Ground and aerial application. For best results, apply during the early morning, before temperatures rise, or during the evening. Use higher rate when conditions favour rapidly increasing populations or when crop canopies are dense, resulting in poor spray coverage. Select nozzle size, type and pressure to produce a medium spray. Use 100–200 L water/ha for ground application, 10–40 L water/ha for aerial application. Maximum 3 applications/yr. 24-hr re-entry period.
		Silencer 120 EC	83 mL (34 mL)	21	**Ground application only.** For best results, apply during the early morning, before temperatures rise, and during the evening. Maximum 3 applications/yr. 24-hr re-entry period.
	dimethoate	Cygon 480 EC	1 L (400 mL)	30	Ground and aerial application. Use high volume, high pressure and ensure good coverage. Maximum 3 applications/yr.
		Lagon 480 EC	1 L (400 mL)		
	imidacloprid + deltamethrin	Concept	325–650 mL (131–263 mL)	20	**Do not apply this product if following a seed treatment or soil application of a Group 4 Insecticide (neonicotinoids) within that season. Ground application only.** Use high rate for fastest knockdown and best residual control. Minimum of 5 days between applications. Maximum 3 applications/yr. 24-hr re-entry period.
TWO-SPOTTED SPIDERMITES (*Tetranychus urticae*)			per ha (per acre)	PHI*	
Scout fields in the first week of July. Infestations usually move in from edge of field as hot spots. Spot spray when populations average 4 mites per leaf. Do not use a pyrethroid insecticide (e.g., Matador) for the control of spidermites, as it will kill the beneficial mites and cause the spidermite populations to increase.	dimethoate	Cygon 480 EC	1 L (400 mL)	30	Ground and aerial application. Use sufficient water volume to ensure good coverage. Maximum 2 applications/yr.
		Lagon 480 EC	1 L (400 mL)		
POTATO LEAFHOPPER (*Empoasca fabae*)			per ha (per acre)	PHI*	
Potato leafhoppers are controlled in soybeans by plant resistance through leaf pubescence. Problems are rare in soybeans in Ontario. Food grade soybeans may need protection.	dimethoate	Cygon 480 EC	0.7–1 L (280–400 mL)	30	Ground and aerial application. Use sufficient water volume to ensure good coverage. Maximum 3 applications/yr.
		Lagon 480 EC	0.7–1 L (280–400 mL)		

* PHI = Pre-Harvest Interval (days)

SOYBEAN INSECTS

Table 2–1. Chemical Control Options for Insects in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
BEAN LEAF BEETLE (*Certoma trifurcata*)					
Seed Treatment			**per 100 kg seed**		
Seed treatment is recommended for those fields with a history of early-season infestation from overwintering adults. Fields in southwestern counties of Ontario in particular tend to experience injury to the seedling crop from early infestations of beetles.	thiamethoxam	Cruiser 5 FS	83 mL		**For use in commercial seed treatment facilities only.** To reduce early-season defoliation. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL		**For use in commercial seed treatment facilities only.** To reduce early-season defoliation. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
Foliar Treatment			**per ha (per acre)**	**PHI***	
For protection from overwintering adults, in areas with a history of injury, consider using insecticide seed treatment for early-planted soybeans. Bean leaf beetle populations rarely cause enough defoliation after the seedling stages to require a foliar insecticide application in Ontario. Defoliation thresholds during the R1–R5 stage are listed in the OMAFRA Publication 811, *Agronomy Guide for Field Crops*. Food-grade and seed soybeans may require protection, especially during the later R5 and R6 pod stages to reduce pod disease development caused by beetle feeding. If 10% of pods have feeding damage, insecticide may be necessary. Pay attention to pre-harvest intervals when spraying during the R6 stage of soybeans.	cyhalothrin-lambda	Matador 120 E	83–233 mL (34–94 mL)	21	Ground and aerial application. For best results, apply during the early morning, before temperatures rise, or during the evening. Use 100–200 L water/ha for ground application, 10–40 L water/ha for aerial application. Maximum 3 applications/yr. 24-hr re-entry period.
		Silencer 120 EC	83 mL (34 mL)	21	**Ground application only.** For best results, apply during the early morning, before temperatures rise, and during the evening. Maximum 3 applications/yr. 24-hr re-entry period.
	dimethoate	Cygon 4 E	0.7–1 L (280–400 mL)	30	Ground and aerial application. Use sufficient water volume to ensure good coverage. Maximum 3 applications/yr.
		Lagon 480 EC	0.7–1 L (280–400 mL)		
	imidacloprid + deltamethrin	Concept	325–650 mL (131–263 mL)	20	**Provides suppression only. Do not apply this product if following a seed treatment or soil application of a Group 4 Insecticide (neonicotinoids) within that season.** Ground application only. Use high rate for fastest knockdown and best residual control. Minimum of 5 days between applications. Maximum 3 applications/yr. 24-hr re-entry period.
JAPANESE BEETLE (*Popillia japonica*)			**per ha (per acre)**	**PHI***	
This pest is most commonly found in the Niagara/Hamilton region, though it is known to be present across Ontario. If the defoliation by adults exceeds the thresholds, insecticide applications may be necessary. Defoliation thresholds for soybeans are available in the OMAFRA Publication 811, *Agronomy Guide for Field Crops*.	imidacloprid + deltamethrin	Concept	325–650 mL (131–263 mL)	20	**Do not apply this product if following a seed treatment or soil application of a Group 4 Insecticide (neonicotinoids) within that season.** Ground application only. Use high rate for fastest knockdown and best residual control. Minimum of 5 days between applications. Maximum 3 applications/yr. 24-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

SOYBEAN DISEASES

Table 2–2. Soybean Seed and Soil-Applied Fungicide Recommendations

Active Ingredients	Product	Formulation	Soybean Diseases				
			Phytophthora	Pythium Damping-Off	Phomopsis Seed Mould	Rhizoctonia Damping-Off	Fusarium Seedling Blight
Insect and Disease Control							
Untreated Seed							
diazinon + captan	Agrox B-2	P (DB)	—	—	+	—	+
thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	F	+	+	+	+	+
Seed Pretreated With Fungicide							
diazinon + captan	Agrox CD	P (DB)	**For insect control only.** Disease control via fungicide pretreatment.				
Disease Control							
captan	Captan	F	—	—	+	—	+
carbathiin + thiram	Anchor	F (DB)	—	—	+	+	+
	Vitaflo-280	F	—	—	+	+	+
fludioxonil	Maxim 480 FS	F	—	—	+	+	+
fludioxonil + metalaxyl-M	Apron Maxx RTA	F	+	+	+	+	+
	Apron Maxx RFC	F	+	+	+	+	+
metalaxyl	Allegiance FL	F	+	+	—	—	—
	Apron FL	F	+	+	—	—	—
metalaxyl-M	Apron XL	LS	+	+	—	—	—
trifloxystrobin	Tilex FS	F	—	—	+	—	+

DB = Drill Box Application F = Flowable P = Powder LS = Liquid Suspension

\+ = Recommended for disease listed — = NOT recommended

SOYBEAN DISEASES

Table 2–3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
SOYBEAN CYST NEMATODE (*Heterodera glycines*)				
Soybean cyst nematode (SCN) is often confused with other common problems such as nutrient deficiencies, herbicide injury, soil compaction, drought, flooding or root rots. By the time above-ground symptoms from SCN feeding become noticeable, most fields have lost 25%–30% yield potential to the nematode. Early detection through scouting and soil testing is critical. If you suspect SCN, plants should be carefully dug (not pulled) and soil gently removed from the roots. Cysts are white to yellow and about the size of a pinhead. Rotating non-host crops such as corn, wheat, alfalfa or vegetable crops such as tomatoes, with resistant varieties, will lower SCN populations and improve yields on SCN-infested fields. In addition, rotation of SCN-resistant varieties is recommended to reduce shifts in the nematode population.				
PHYTOPHTHORA ROOT ROT (*Phytophthora sojae*)				
Seed Treatment			**per 100 kg seed**	
Select soybean varieties that have both specific resistance (Rps genes such as 1K and 1C) and good partial resistance (tolerance) to all races of *Phytophthora*. Consult with your seed company and the Ontario Oil and Protein Seed Crop Committee Variety Trial Results at www.gosoy.ca for variety profiles. This disease is primarily controlled through resistant varieties. Crop losses are greatest in cold, wet, clay soils. Try to minimize soil compaction and remove excess moisture through improved drainage. A small amount of tillage will help warm the soil and improve surface drainage. Rotate soybeans with corn and wheat. Plant seed when soil temperatures are above 13°C.	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Provides early-season protection for tolerant varieties. If target fields have a history of high *Phytophthora* pressure, or if susceptible varieties are to be treated, tank-mix with 31 mL per 100 kg seed of Apron XL LS. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For both commercial seed treatment plants and on-farm treatment. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. Provides early-season protection against phytophthora root rot for tolerant varieties of soybeans. If target fields have a history of high pressure or if susceptible varieties are to be treated, tank-mix with 31 mL of Apron XL LS per 100 kg seed.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	**For use in commericial treatment facilities only.** Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. Provides early-season protection against phytophthora root rot for tolerant varieties of soybeans. If target fields have a history of high pressure or if susceptible varieties are to be treated, tank-mix with 31 mL of Apron XL LS per 100 kg of seed.
	metalaxyl-M	Apron XL-LS	40 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL	46–93 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL		

* PHI = Pre-Harvest Interval (days)

SOYBEAN DISEASES

Table 2–3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
PHOMOPSIS SEED MOULD (*Phomopsis longicolla*)				
Seed Treatment			**per 100 kg seed**	
This disease is most severe when cool, wet conditions delay harvest. Some varieties are more susceptible than others. Consult with your seed company and the Ontario Oil and Protein Seed Crop Committee Variety Trial Results at www.gosoy.ca for variety profiles. Fungicide seed treatments will improve the germination of low to moderately infected seed. Do not plant severely infected seed. Plant good-quality seed with a germination rate of at least 80%–90%. Rotate with non-host crops such as corn and wheat, remove excess surface residue and harvest as early as possible.	carbathiin + thiram	Anchor	600 mL	For drill box application. Ensure uniform coverage on seed. Do not apply Anchor through commercial seed-treating equipment or through an auger, as excessive seed wetness may result. Do not graze or feed livestock on treated areas for 4 weeks after planting.
		Vitaflo 280	260 mL	Do not store treated soybean seed. May be applied through commercial seed treatment equipment or auger. Ensure uniform coverage.
	captan	Captan Flowable	280 mL	Mix with the amount of water required for the slurry treater equipment to be used.
	fludioxonil	Maxim 480 FS	5.2–10.4 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze treated crops or cut for forage within 30 days of planting.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For both commercial seed treatment plants and on-farm application. Compatible with *Rhizobium*-based inoculants. Check with inoculants manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	**For use in commercial seed treatment facilities only.** Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	trifloxystrobin	Trilex FS	21 mL	**For use in commercial seed treatment facilities only.** Apply using standard commercial seed treatment equipment. Not for use in hopper-box, planter-box, slurry-box or similar seed treatment applications. Uniform application on seed is necessary to ensure seed safety and best disease protection.

* PHI = Pre-Harvest Interval (days)

SOYBEAN DISEASES

Table 2–3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
RHIZOCTONIA DAMPING-OFF (*Rhizoctonia solani*)				
Seed Treatment			**per 100 kg seed**	
This disease can occur on all soil types and environmental conditions. Disease losses are greatest when a dry spring is followed by wet conditions. Few management options exist since no resistant or tolerant varieties are available. Seed treatment and crop rotation with corn and small grains can help minimize the disease.	fludioxonil	Maxim 480 FS	5.2–10.4 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze treated crops or cut for forage within 30 days of planting.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	**For use in commercial seed treatment facilities only.** Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	carbathiin + thiram	Anchor	600 mL	For drill box application. Ensure uniform coverage on seed. Do not apply Anchor through commercial seed-treating equipment or through an auger, as excessive seed wetness may result. Do not graze or feed livestock on treated areas for 4 weeks after planting.
		Vitaflo 280	260 mL	Do not store treated soybean seed. May be applied through commercial seed treatment equipment or auger. Ensure uniform coverage.

* PHI = Pre-Harvest Interval (days)

SOYBEAN DISEASES

Table 2–3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
PYTHIUM DAMPING-OFF (*Pythium* spp.)				
Seed Treatment			**per 100 kg seed**	
This disease can occur on all soil types but crop losses are greatest in cold, wet, clay soils. Try to minimize soil compaction and remove excess moisture through increased drainage. Plant seed when soil temperatures are above 13°C. Treat seed with metalaxyl or metalaxyl-M. There is no known resistance but there is some degree of tolerance available in varieties. Consult with your seed company and the Ontario Oil and Protein Seed Crop Committee Variety Trial Results at www.gosoy.ca for variety profiles. Crop rotation has limited effect. *Pythium* control is less affected by product rate.	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity or mist-type seed treatment equipment. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	**For use in commercial seed treatment facilities only.** Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	metalaxyl	Allegiance FL	46–93 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL		
	metalaxyl-M	Apron XL LS	20–40 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.

* PHI = Pre-Harvest Interval (days)

SOYBEAN DISEASES

Table 2–3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
FUSARIUM SEEDLING BLIGHT (*Fusarium oxysporum* or *Fusarium solani*)				
Seed Treatment			**per 100 kg seed**	
Cool, wet spring conditions favour infection. Resistant varieties are not available. Minimize soil compaction and remove excess soil moisture through improved drainage. A small amount of tillage will help warm soil and improve surface drainage. Rotate with corn and wheat. Plant high-quality seed when soil temperatures are above 13°C. Fungicide seed treatment recommended. Mounding or ridging soil at the base of the plants produces adventitious roots that can minimize losses.	fludioxonil	Maxim 480 FS	5.2–10.4 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze treated crops or cut for forage within 30 days of planting.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	**For use in commercial seed treatment facilities only.** Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	carbathiin + thiram	Anchor	600 mL	For drill box application. Ensure uniform coverage on seed. Do not apply Anchor through commercial seed-treating equipment or through an auger, as excessive seed wetness may result. Do not graze or feed livestock on treated areas for 4 weeks after planting.
		Vitaflo 280	260 mL	Do not store treated soybean seed. May be applied through commercial seed-treatment equipment or auger. Ensure uniform coverage.
	diazinon + captan	Agrox B-2	320 g	Available as a 2-kg container that will treat 625 kg of soybean seed. Use full rate and ensure good coverage of seed. Seed within 1 month of treatment. Do not use on seed already treated with an insecticide.
	captan	Captan Flowable	280 mL	Mix with the amount of water required for the slurry treater equipment to be used.
	trifloxystrobin	Trilex FS	21 mL	**For use in commercial seed treatment facilities only.** Apply using standard commercial seed treatment equipment. Not for use in hopper-box, planter-box, slurry-box or similar seed treatment applications. Uniform application on seed is necessary to ensure seed safety and best disease protection.

* PHI = Pre-Harvest Interval (days)

SOYBEAN DISEASES

Table 2–3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate		Comments (label precautions, re-entry periods, etc.)
WHITE MOULD (*Sclerotinia sclerotiorum*)					
Foliar Treatment			per ha (per acre)	PHI*	
White mould is a sporadic disease that thrives under cool, wet conditions during flowering or near harvest. Fields at risk have a history of white mould, good leaf growth, high plant populations and more than 48 hr of continuous wetness and air temperatures between 15°C and 20°C (day and night average temperatures).	*Coniothyrium minitans*	Contans WG	0.5–4 kg (0.20–1.6 kg)	0	**Provides suppression only. Ground application only.** Good option for organically grown soybeans. This product should be applied at least 3 months prior to anticipated outbreak (i.e., prior to planting). Product should be incorporated as thoroughly as possible to a depth of 5–20 cm. Rate should be increased to 2–4 kg/ha (0.8–1.6 kg/acre) if incorporated to a depth greater than 5 cm. A post-harvest application may be applied in the fall to treat the soil prior to spring planting of a susceptible crop. Treated soils in the fall should not be disturbed to avoid bringing untreated sclerotia from lower soil layers to the top soil layer. Maximum 2 applications/yr.
In fields with a history of white mould, use non-host crops and avoid growing other host crops such as canola, edible beans, buckwheat and sunflowers for 2–3 yr. Plant a tolerant variety, although none are resistant (immune), select a variety with good lodging resistance and keep sclerotia on the surface through conservation tillage practices. Consult with your seed company and the Ontario Oil and Protein Seed Crop Committee Variety Trial Results at www.gosoy.ca for variety profiles.	*Bacillus subtilis*	Serenade ASO	4.0–15.0 L (1.6–6.0 L)	0	**Provides suppression only.** Ground and aerial application. Good option for organically grown soybeans. Under conditions of moderate to high disease pressure, use the higher rate and shorter application intervals. For maximum effectiveness, apply prior to, or at the early stages of disease development. Apply in sufficient water volume to ensure full coverage for effective control. Repeat as necessary on a 7–10-day interval.

* PHI = Pre-Harvest Interval (days)

SOYBEAN DISEASES

Table 2–3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
POWDERY MILDEW (*Microsphaera diffusa*)			per ha (per acre)	PHI*	
This disease is most noticeable when conditions are wet or humid. Powdery mildew develops on the leaves, usually in August and September. Outbreaks arise when disease symptoms begin in early July and the environmental conditions remain cool, cloudy and humid through to pod fill. Removal of crop residue and rotation with non-host crops, such as corn and wheat, will help prevent both diseases.	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	20	Ground and aerial application. Apply when first symptoms of disease can be found or when risk of infection is imminent. Use the higher rate when disease pressure is severe. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Maximum 1 application/yr. 12-hr re-entry period.
		Folicur 432 F	220–292 mL (90–118 mL)	20	Ground and aerial application. Apply when first symptoms of disease can be found or when risk of infection is imminent. Use the higher rate when disease pressure is severe. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Always use a non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Maximum 1 application/yr. 12-hr re-entry period.
	propiconazole	Tilt 250 E	500 mL (200 mL)	30	Ground and aerial application. First application should be made at the first sign of disease, followed by a second application 14 days after the first application, if environmental conditions are favourable for disease development. Good spray coverage and canopy penetration are important for best results. See label for resistance management strategy. Maximum 2 applications/yr.
	azoxystrobin	Quadris	500 mL (200 mL)	15	Ground and aerial application. See label for resistance management strategy. Maximum 2 applications/yr. Re-entry possible once residues have dried.
	azoxystrobin + propiconazole	Quilt	1.0 L (400 mL)	30	Ground and aerial application. First application should be made at the first sign of disease, followed by a second application 14 days after the first application, if environmental conditions are favourable for disease development. Good spray coverage and canopy penetration are important for best results. See label for resistance management strategy. Maximum 2 applications/yr.

* PHI = Pre-Harvest Interval (days)

SOYBEAN DISEASES

Table 2–3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
ASIAN SOYBEAN RUST (*Phakopsora pachyrhizi*)					
Foliar Treatment			**per ha (per acre)**		
Asian soybean rust is an invasive fungal disease. Scouting and early detection are critical to managing this disease. The early stages of the disease can be confused with other common foliar diseases such as septoria brown spot, bacterial pustule, downy mildew, frog-eye leaf spot and bacterial blight. Numerous factors such as crop stage (R1–R6), yield potential, disease risk or presence are critical components of the fungicide decision process. Strobilurin fungicides such as Headline or Quadris are protective products that stop spore germination and penetration into the soybean leaf. The strobilurins have no effect on the fungus once inside the leaf. Since the strobilurin group of fungicides have no curative activity, do not make solo applications of a strobilurin if any rust is present. The triazole fungicides such as Tilt and Folicur have varying protective abilities and are usually considered "early post-infection" fungicides. The post-infection or curative abilities are limited, and the fungicides may not perform well if 5%–10% disease is present in the lower crop canopy. Combination products containing both a strobilurin and triazole fungicide such as Quilt have preventive (pre-infection) and curative (post-infection) properties.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	21	Ground and aerial application. Classified as a strobilurin fungicide; use this product in a preventive fungicide program (pre-infection). See label for resistance management strategy. Maximum 2 applications/yr.
	azoxystrobin	Quadris	500 mL (200 mL)	15	Ground and aerial application. Classified as a strobilurin fungicide; use this product in a preventive fungicide program (pre-infection). See label for resistance management strategy. Maximum 2 applications/yr. Re-entry possible once residues have dried.
	propiconazole	Tilt 250 E	500–750 mL (200–300 mL)	30	Ground and aerial application. First application should be made at the first sign of disease, followed by a second application 14 days after the first application, if environmental conditions are favourable for disease development. Good spray coverage and canopy penetration are important for best results. See label for resistance management strategy. Maximum 2 applications/yr.
	azoxystrobin + propiconazole	Quilt	1.0–1.5 L (400–600 mL)	30	Ground and aerial application. First application should be made at the first sign of disease, followed by a second application 14 days after the first application, if environmental conditions are favourable for disease development. Good spray coverage and canopy penetration are important for best results. See label for resistance management strategy. Maximum 2 applications/yr.
	prothioconazole	Proline 480 SC	210 mL (85 mL)	20	**Ground application only.** Apply when first symptoms of disease can be found or the risk of infection is imminent. Maximum 1 application/yr. 24-hr re-entry period.
	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	20	Ground and aerial application. Apply when first symptoms of disease can be found or when risk of infection is imminent. Use the higher rate when disease pressure is severe. Use a minimum of 100 L of water for ground application, 47 L of water for aerial application. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Maximum 1 application/yr. 12-hr re-entry period.
		Folicur 432 F	220–292 mL (90–118 mL)	20	Ground and aerial application. Apply when first symptoms of disease can be found or when risk of infection is imminent. Use the higher rate when disease pressure is severe. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Always use a non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Maximum 1 application/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

SOYBEAN DISEASES

Table 2–3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate		Comments (label precautions, re-entry periods, etc.)
ASIAN SOYBEAN RUST (*Phakopsora pachyrhizi*) cont'd					
Foliar Treatment (cont'd)			per ha (per acre)	PHI*	
(cont'd) Long periods of leaf wetness are needed for spore germination, as well as temperatures between 15°C and 30°C and a high relative humidity. Yield loss is very likely once rust can be found in the mid-crop canopy. For these reasons, scouting, fungicide selection, timing and application are critical to successful management of soybean rust. For further information on scouting techniques, sentinel plots, thresholds, management options and emergency use registrations, see OMAFRA Publication 811, *Agronomy Guide for Field Crops*, as well as the Grain Farmers of Ontario website at www.gfo.ca.	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	20	Ground and aerial application. Begin applications preventatively from early flowering (R1) to complete pod fill (R5) when risk of rust infection is high. Use 100–200 L/ha of water for ground application, 50 L/ha for aerial application. Maximum 2 applications/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

SOYBEAN DISEASES

Table 2–3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
FROGEYE LEAF SPOT (*Cercospora sojina*)					
Foliar Treatment			per ha (per acre)		
The economic impact of this disease is minimal. Frogeye leaf spot occurs under hot, humid conditions particularly on very susceptible varieties. Consult with your seed company and the Ontario Oil and Protein Seed Crop Committee Variety Trial Results at www.gosoy.ca for variety profiles. This disease is most frequent in the extreme southwest counties.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	21	Ground and aerial application. First application should be applied at the first sign of disease followed by the second application 14 days after, if environmental conditions are favourable for disease development. Maximum 2 applications/yr. 12-hr re-entry period.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	20	Ground and aerial application. Spray between R3 and R4 (early pod fill) or when first symptoms appear. Use 100–200 L/ha of water for ground application, 50 L/ha for aerial application. Maximum 2 applications/yr. 12-hr re-entry period.
	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	20	Ground and aerial application. Apply when first symptoms of disease can be found or when risk of infection is imminent. Use the higher rate when disease pressure is severe. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Maximum 1 application/yr. 12-hr re-entry period.
		Folicur 432 F	220–292 mL (90–118 mL)	20	Ground and aerial application. Apply when first symptoms of disease can be found or when risk of infection is imminent. Use the higher rate when disease pressure is severe. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Always use a non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Maximum 1 application/yr. 12-hr re-entry period.
	prothioconazole	Proline 480 SC	210 mL (85 mL)	20	**Ground application only.** Apply when first symptoms of disease can be found or that the risk of infection is imminent. Maximum 1 application/yr. 24-hr re-entry period.
	propiconazole	Bumper 418 EC	300–455 mL (121–184 mL)	50	**For use on soybeans grown for seed only. Ground application only.** Apply when disease first appears. Under severe disease pressure, make a second application 14 days after. Harvested soybean seed should not be used for human food or animal feed.
		Tilt 250 E	500–760 mL (200–308 mL)	30	**Ground application only.** Apply when disease symptoms first appear. Under severe disease pressure, make a second application 14 days after. Harvested soybean seed should not be used for human food or animal feed.
	Bacillus subtilis	Serenade ASO	1.0–4.0 L (0.4–1.6 L)	0	**Provides suppression only.** Ground and aerial application. Good option for organically grown soybeans. Under conditions of moderate to high disease pressure, use the higher rate and shorter application intervals. For maximum effectiveness, apply prior to, or at the early stages of disease development. Apply in sufficient water volume to ensure full coverage for effective control. Repeat as necessary on a 7–10-day interval.

* PHI = Pre-Harvest Interval (days)

3. Forages

FORAGE CROP INSECTS

Table 3–1. Chemical Control Options for Insects in Forage Crops

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
ALFALFA SNOUT BEETLE (*Otiorhynchus ligustici*)					
No chemical control options available. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for management information.					
ALFALFA WEEVIL (*Hypera postica* Gyll)			**per ha (per acre)**		
First cut: If there is 40% leaf-tip feeding, with 2 or 3 active weevils per stem, and there is more than 7–10 days to preferred harvest date, consider applying an insecticide. ("Leaf-tip feeding" refers to the percent of plant tips showing obvious signs of damage, which is not to be confused with the percent defoliation.) • Less than 1 active larva per stem does not require action, but continue to monitor the situation. • Two larvae per stem requires action if the alfalfa is less than 40 cm high. • If there are more than 3 active larvae, immediate action is required. **Second Cut:** If damage was serious on first cut, feeding may continue. Check early regrowth carefully for damage and larvae. Natural enemies are generally highly effective at controlling this pest. For the safety of these natural enemies, chemical control is not recommended unless pest population exceeds the action threshold. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information.	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	3 (livestock foraging)	**For use in alfalfa only.** Ground and aerial application. Allow 7 days between treatments. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. Maximum 3 applications/yr. Do not apply more than 1 application by air. 24-hr re-entry period.
		Silencer 120 EC	83 mL (34 mL)	3 (livestock foraging)	**For use in alfalfa only. Ground application only.** Allow 7 days between treatments. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. Maximum 3 applications/yr. 24-hr re-entry period.
	phosmet	Imidan 50 WP	2.25 kg (900 g)	7	**For use in alfalfa only. Ground application only.** Do not apply during bloom. Maximum 3 applications/yr. Do not apply more than 1 application per cutting. **5-day re-entry period.**
	chlorantraniliprole	Coragen	375–500 mL (151–202 mL)	0	**Provides suppression only. For use in alfalfa only. Ground application only.** Begin applications when treatment thresholds have been reached. Thorough coverage is important. Use a minimum of 100 L/ha of water by ground. Maximum 1 application per cutting. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

FORAGE CROP INSECTS

Table 3–1. Chemical Control Options for Insects in Forage Crops

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
POTATO LEAFHOPPER (*Empoasca fabae*)			per ha (per acre)		
Leafhopper damage is most severe in new seedings and during regrowth after cutting, particularly when the weather is hot and dry. Resistant varieties that produce glandular hairs on the leaves and stems are recommended for control. Use chemical control only if leafhoppers exceed the threshold, as insecticides will also kill beneficial insects, the natural enemies of alfalfa weevil and lygus bug. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for thresholds.	dimethoate	Cygon 480 EC	425 mL (170 mL)	2	Ground and aerial application. Do not apply during bloom. Maximum 2 applications/yr.
		Lagon 480 EC	425 mL (170 mL)		
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	3 (livestock foraging)	**For use in alfalfa only.** Ground and aerial application. Allow 7 days between treatments. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. Maximum 3 applications/yr. Do not apply more than 1 application by air. 24-hr re-entry period.
		Silencer 120 EC	83 mL (34 mL)	3 (livestock foraging)	**For use in alfalfa only. Ground application only.** Allow 7 days between treatments. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. Maximum 3 applications/yr. Do not apply more than 1 application by air. 24-hr re-entry period.
EUROPEAN SKIPPER (*Thymelicus lineola*)			per ha (per acre)		
If 6–8 larvae in a 30 cm x 30 cm area are found and larvae are still small, treat the field or the infested area. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for scouting procedures.	*Bacillus thuringiensis* (Bt)	Dipel 2X DF	140–275 g (60–115 g)	0	**For use in timothy only.**
		Thuricide HPC	2.25 L (900 mL)	0	For use in timothy and other forage grasses.
GRASSHOPPERS (Various species)			per ha (per acre)		
Begin scouting in late June when grasshoppers are still young. Spraying insecticides on alfalfa will also kill the natural enemies of alfalfa weevil and lygus bugs.	cyhalothrin-lambda	Matador 120 E	63–83 mL (26–34 mL)	3 (livestock foraging)	**For use in alfalfa only.** Ground and aerial application. Allow 7 days between treatments. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. Maximum 3 applications/yr. Do not apply more than 1 application by air. 24-hr re-entry period.
		Silencer 120 EC			
	malathion	Malathion 500 EC	2.25–2.75 L (0.9–1.1 L)	7	For use in alfalfa and clover. Do not apply during bloom. Apply when 75% of foliage shows feeding damage. Product is less effective when temperatures are below 20°C.

* PHI = Pre-Harvest Interval (days)

FORAGE CROP INSECTS

Table 3–1. Chemical Control Options for Insects in Forage Crops

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
ALFALFA BLOTCH LEAFMINER (*Agromyza frontella*)			per ha (per acre)		
Natural enemies are highly effective at controlling this pest. For the safety of these natural enemies, chemical control is not recommended unless pest population exceeds the action threshold. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information.	dimethoate	Cygon 480 E	550 mL (220 mL)	2	Ground and aerial application. Do not apply during bloom. Maximum 2 applications/yr.
		Lagon 480 E	550 mL (220 mL)		
	phosmet	Imidan 50 WP	2.25 kg (900 g)	7	**For use in alfalfa only. Ground application only.** Do not apply during bloom. Maximum 3 applications/yr. Do not apply more than 1 application per cutting. **5-day re-entry period.**
ARMYWORM (TRUE – *Pseudaletia unipuncta*, FALL – *Spodoptera frugiperda*)			per ha (per acre)		
Control is warranted when 5 or more larvae (smaller than 2.5 cm) per 30 cm x 30 cm (square foot) are found. Avoid treating with insecticides when large numbers of parasitized larvae are present. In seedling crops, two to three larvae (smaller than 2.5 cm) per 30 cm x 30 cm may warrant control. If larvae have white eggs attached to them, they are parasitized and may not need treatment. If the larvae are almost full grown (2.5 cm or larger), there is no benefit in applying insecticide since most of the feeding damage has already been done.	carbaryl	Sevin XLR Plus	2.5–5.25 L (1.0–2.1 L)	2	For use in alfalfa, clover and forage grasses. 1-day re-entry period for beef cattle. 2-day re-entry period for dairy cattle.
	chlorantraniliprole	Coragen	250–375 mL (101–151 mL	0	**For use in grass forages for seed production only. Ground application only.** Begin applications when treatment thresholds have been reached. Thorough coverage is important. Use a minimum of 100 L/ha of water by ground. Do not feed treated crop to livestock. Maximum 1 application/cutting. Maximum 4 applications/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

FORAGE CROP DISEASES

Table 3–2. Chemical Control Options for Diseases in Forage Crops

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
SEED and ROOT ROTS				
PHYTOPHTHORA ROOT ROT (*Phytophthora medicaginis*)				
Seed Treatment			**per 100 kg seed**	
Plant resistant varieties that are treated with metalaxyl or metalaxyl-M. Consult with your seed company and the Ontario Forage Crops Committee Variety Trial Results at www.uoguelph.ca/plant/performance_recommendations/ofcc/ofcc.htm for variety profiles. Drain excess moisture from soil and avoid compaction. Avoid other stresses such as insects, weeds and untimely cuttings that may stress the plants and make them more susceptible to *Phytophthora*. Do not cut during wet conditions. Crop rotation has little effect on the disease. Promote lateral root growth by following a good fertility program.	metalaxyl-M	Apron XL LS	40 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL Apron FL	46–110 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
PYTHIUM DAMPING-OFF (*Pythium* spp.)				
Seed Treatment			**per 100 kg seed**	
Drain excess moisture from the soil and avoid compaction. Plant seed when soil and weather conditions favour rapid emergence and early growth of seedlings. Increase plant populations to compensate for any plant losses.	metalaxyl-M	Apron XL LS	20–40 mL 40 mL	Use 20–40 mL for forage grasses. Use 40 mL for alfalfa, clover, trefoil and vetch. **For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed-treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information on resistant strains of fungus.
	metalaxyl	Allegiance FL Apron FL	46–110 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.

FORAGE CROP DISEASES

Table 3–2. Chemical Control Options for Diseases in Forage Crops

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
FOLIAR and STEM DISEASES				
VERTICILLIUM WILT (*Verticillium albo-atrum*)				
Seed Treatment			**per 100 kg seed**	
Planting resistant or highly resistant varieties is the best means of control for this disease. Consult with your seed company and the Ontario Forage Crops Committee Variety Trial Results at www.uoguelph.ca/plant/performance_recommendations/ofcc/ofcc.htm for variety profiles. The fungus is spread primarily on the cutting bar of forage harvesting equipment. Before harvesting, clean the cutting bar with a 1% solution of bleach followed by a clean water rinse and oil spray. Cut the youngest fields first, working towards the oldest fields. Wait 2–3 yr between alfalfa crops. Maintain a good weed control program, since some weeds can be alternate hosts.	thiram	Thiram 75 WP	360 g	**For use on alfalfa only.** Do not graze treated areas or feed clippings from treated areas to livestock.
WHITE MOULD/BLOSSOM BLIGHT (*Sclerotinia sclerotiorum/Botrytis cinerea*)				
Foliar Treatment			**per ha (per acre)**	
There are some differences in white mould susceptibility between cultivars. Fields established under minimum tillage may have more disease incidence. Spring planting may reduce disease incidence.	boscalid	Lance	420 g (170 g)	**For use in alfalfa for seed production only.** Ground and aerial application. Apply at 20%–50% flowering. Apply every 7–14 days if disease persists or weather conditions are favourable for disease development. **Do not graze or feed treated hay to livestock.** Maximum 3 applications/yr. 12-hr re-entry period.
COMMON LEAF SPOT (*Pseudopeziza medicaginis*)				
Foliar Treatment			**per ha (per acre)**	
Timely harvesting of forages is important to reduce leaf loss and minimize disease in the re-growth. There are no practical control strategies available for leaf spot diseases in forages. Balance the time of harvest between the optimum stage for highest protein (bud stage in alfalfa) and the level of leaf spot disease, as leaf spot can reduce the protein level in legume leaves.	boscalid	Lance	420 g (170 g)	**For use in alfalfa for seed production only.** Ground and aerial application. Apply at 20%–50% flowering. Apply every 7–14 days if disease persists or weather conditions are favourable for disease development. **Do not graze or feed treated hay to livestock.** Maximum 3 applications/yr. 12-hr re-entry period.
	mancozeb	Dithane DG Rainshield NT	1.46 kg (584 g)	**For use in alfalfa for seed production only.** Apply prior to 50% bloom. Repeat 7–10 days after first application and 10 days after second application. **Do not graze treated crop or cut for hay.** Maximum 3 applications/yr.

FORAGE CROP DISEASES

Table 3–2. Chemical Control Options for Diseases in Forage Crops

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
LEAF SPOT (*Leptosphaerulina trifolii*)				
Foliar Treatment			per ha (per acre)	
Timely harvesting of forages is important to reduce leaf loss and minimize disease in the re-growth. There are no practical control strategies available for leaf spot diseases in forages. Balance the time of harvest between the optimum stage for highest protein (bud stage in alfalfa) and the level of leaf spot disease, as leaf spot can reduce the protein level in legume leaves.	boscalid	Lance	420 g (170 g)	**For use in alfalfa for seed production only.** Ground and aerial application. Apply at 20%–50% flowering. Apply every 7–14 days if disease persists or weather conditions are favourable for disease development. **Do not graze or feed treated hay to livestock.** Maximum 3 applications/yr. 12-hr re-entry period.
	mancozeb	Dithane DG Rainshield NT	1.46 kg (584 g)	**For use in alfalfa for seed production only.** Apply prior to 50% bloom. Repeat 7–10 days after first application and 10 days after second application. **Do not graze treated crop or cut for hay.** Maximum 3 applications/yr.
SPRING BLACK STEM (*Phoma medicaginis*)				
Foliar Treatment			per ha (per acre)	
This disease is favoured by cool, wet weather conditions. Cut the crop early to reduce quality loss from premature leaf drop.	boscalid	Lance	420 g (170 g)	**For use in alfalfa for seed production only.** Ground and aerial application. Apply at 20%–50% flowering. Apply every 7–14 days if disease persists or weather conditions are favourable for disease development. **Do not graze or feed treated hay to livestock.** Maximum 3 applications/yr. 12-hr re-entry period.

4. Cereals

WHEAT, BARLEY, OAT AND RYE INSECTS

Table 4–1. Chemical Control Options for Insects in Cereals

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
WIREWORMS (*Limonius* spp. and others)				
Seed Treatment			**per 100 kg seed**	
See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for sampling methods. 1 wireworm/bait trap warrants control.	thiamethoxam	Cruiser 5 FS	33–50 mL	For use in wheat and barley. **For use in commercial seed treatment facilities only.** Use higher rate in fields with a history of high infestations of larvae. Do not graze or feed livestock on treated areas for 45 days after planting.
EUROPEAN CHAFER (*Rhizotrogus majalis*)			**per 100 kg seed**	
High-risk areas for chafer within a field include sandy knolls and areas bordering turf, pasture and tree lines. Chafer grub infestations can occur one year after soybean crops on sandy soils. Avoid planting winter wheat if chafer grub populations are extreme (more than four grubs per 30 cm x 30 cm (square foot)). See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more details.	thiamethoxam	Cruiser 5 FS	50 mL	For use in wheat and barley. **For use in commercial seed treatment facilities only.** Do not graze or feed livestock on treated areas for 45 days after planting.

* PHI = Pre-Harvest Interval (days)

WHEAT, BARLEY, OAT AND RYE INSECTS

Table 4–1. Chemical Control Options for Insects in Cereals

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
ARMYWORM (TRUE – *Pseudaletia unipuncta*, FALL – *Spodoptera frugiperda*)			**per ha (per acre)**	**PHI***	
Five to six larvae in a 30 cm x 30 cm area warrant chemical control. Treat if larvae are smaller than 2.0 cm long and threshold has been exceeded. If larvae have white eggs attached to them, they are parasitized and may not require treatment.	trichlorfon	Dylox 420 LC	1.5 L (0.6 L)	21	**Ground application only.** 24-hr re-entry period.
	carbaryl	Sevin XLR Plus	2.5–5.25 L (1.0–2.1 L)	14 (wheat, rye, oat) 28 (barley)	See label precautions applying to honeybees.
	methomyl	Lannate Toss-N-Go	270–540 g (108–216 g)	20	Ground and aerial application. 24-hr re-entry period.
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	28 (wheat, barley, oat) 14 (livestock foraging)	Ground and aerial application. Use 100–200 L of water/ha. Allow a 7-day interval between treatments. Maximum 3 applications/yr. Do not apply more than 2 applications by air. 24-hr re-entry period.
	spinetoram	Delegate WG	100–200 g (40–80 g)	21	**Ground application only.** Use higher rate for heavy infestations or advanced pest stages. Spray tank solution pH should be between 6 and 8 for optimal control. Minimum 5 days between treatments. Maximum 3 applications/yr. 12-hr re-entry period.
CEREAL LEAF BEETLE (*Oulema melanopus*)			**per ha (per acre)**	**PHI***	
Natural enemies are highly effective at controlling this pest. For the safety of these natural enemies, chemical control is not recommended unless pest population exceeds the action threshold of 1 larva/stem. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information.	malathion	Malathion 500 EC	2.2 L (880 mL)	7	Product is less effective at temperatures below 20°C.

* PHI = Pre-Harvest Interval (days)

WHEAT, BARLEY, OAT AND RYE INSECTS

Table 4–1. Chemical Control Options for Insects in Cereals

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
GRASSHOPPERS (Various species)			**per ha (per acre)**	**PHI***	
Grasshoppers are more abundant in drier years. If populations are high enough, wheat heads may be clipped. Seedling winter wheat is also at risk. Infestations usually begin along field borders. Early-season weed control can help eliminate food source for early-season nymphs, however, late-season weed control in and around the field will actually cause this insect to migrate from the weeds onto the crop and cause damage. If populations are high, spot spray in border areas that are infested before migration into the field occurs.	malathion	Malathion 500 EC	2.25–2.75 L (900–1,100 mL)	7	Product is less effective at temperatures below 20°C.
	cypermethrin	Ripcord 400 EC	50–70 mL (20–28 mL)	30 (wheat) 45 (barley)	For use in wheat and barley. **Ground application only.** Use lower rates for small grasshoppers and when soil temperatures are cool (15°C–20°C). Avoid spraying when temperatures are above 25°C. Repeat treatment as necessary. Do not graze treated crop or cut for hay.
	cyhalothrin-lambda	Matador 120 E Silencer 120 EC	63–83 mL (26–34 mL)	28 (wheat, barley, oat) 14 (livestock foraging)	Ground and aerial application. Apply the low rate when grasshoppers are up to the 3rd nymphal stage (up to 1 cm in length) or when insect numbers are low. Apply the high rate when grasshoppers are larger, up to but not including winged adults (up to 2.5 cm in length) or when insect numbers are high. Allow a 7-day interval between treatments. Maximum 3 applications/yr. Do not apply more than 2 applications by air. 24-hr re-entry period.
	carbaryl	Sevin XLR Plus	1.25–2.5 L (0.5–1.0 L)	14 (wheat, rye, oat) 28 (barley)	See label precautions applying to honeybees.
	spinetoram	Delegate WG	100–200 g (40–80 mg)	21	**Ground application only.** Minimum of 5 days between applications. Spray tank solution pH should be between 6 and 8 for optimal control. Maximum 3 applications/yr. 12-hr re-entry period.
GROWTH REGULATORS FOR LODGING REDUCTION IN CEREALS			**per ha (per acre)**	**PHI***	
Visit the Ontario Cereal Crops Committee website at www.gocereals.ca for performance trial information. High-risk factors for lodging include fields with a history of manure applications and legume hay.	ethephon	Ethrel	Spring Barley 1.0–1.5 L (0.4–0.6 L) ***2-row cultivar*** 1.0–2.0 L (0.4–0.8 L) ***6-row cultivar*** Spring Wheat 1.0–1.5 L (0.4–0.6 L) Winter Wheat 1.25–2.5 L (0.5–1.0 L)	35	Ground and aerial application. Timing of application is critical. Use lower rate unless expecting severe lodging conditions. Apply when most of the tillers are between early flag leaf emergence to swollen boot stage (Zadok's 37–45). Do not apply after more than 10% of the awns have emerged (Zadok's 49). Use higher rates on crops that are heavily fertilized (more than 100 kg/ha of total available nitrogen) and have ample moisture (more than 25 cm of precipitation) and are prone to lodging.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–2. Wheat Seed and Soil-Applied Fungicide Recommendations

Active Ingredient	Products	Formulation	Seed-Borne				Soil-Borne						Early-Season	
			Loose Smut	Seed-Borne Septoria	Seed-Borne Fusarium	Seed-Borne Dwarf Bunt	Soil-Borne Dwarf Bunt	Common Bunt	Common Root Rot	Take All	Pythium Damping-Off	Soil-Borne Fusarium	Powdery Mildew	Septoria
carbathiin + thiram	Vitaflo-280	F	+	—	+	+	—	+	+	—	—	+	—	—
difenoconazole + metalaxyl-M	Dividend XL	F	+	+	+	+	+	+	S	S	+	+	—	+[1]
	Dividend XL RTA	F	+	+	+	+	+	+	S	S	+	+	—	+[1]
fludioxonil	Proseed	F	—	—	+	—	—	—	—	—	—	+	—	—
ipconazole	Rancona Apex	F	+	—	+	—	—	+	S	—	—	+	—	—
metalaxyl-M	Apron XL	F	—	—	—	—	—	—	—	—	+	—	—	—
tebuconazole + metalaxyl	Raxil MD	F	+	+	+	—	—	+	S	—	+	+	—	—
tebuconazole + thiram	Raxil T	F	+	+	+	—	—	+	S	—	+	+	—	—
triticonazole + thiram	Gemini	F	+	—	+	—	—	+	—	—	+	—	—	—
triadimenol	Baytan 30	F	+	—	—	—	—	+	—	S	—	—	+	—

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable P = Powder

+ = Recommended for disease listed — = Not Recommended S = Suppression only.

[1] Winter wheat only.

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
SEED ROTS and SEED-BORNE DISEASES				
Use good-quality, clean seed. Apply fungicide seed treatment to all wheat seed to control soil-borne and seed-borne diseases such as seed rots and seedling blights, seed-borne septoria, seed-borne fusarium seedling blight, seed-borne dwarf bunt, common bunt and loose smut. The best protection against seedling blights, smut and the bunts can be achieved through the use of a seed treatment that contains a combination of fungicides, since no one fungicide is effective against all these diseases. Good coverage of the seed is essential, otherwise performance will be reduced.				
SEED-BORNE SEPTORIA (*Stagonospora nodorum*, formerly *Septoria nodorum*)				
Seed Treatment			**per 100 kg seed**	
Infected seed is lightweight and shrivelled. Fungicide seed treatment is very effective against this disease. Other options include the use of tolerant varieties and disease-free seed. Consult with your seed company and the Ontario Cereal Crops Committee Variety Trial Results at www.gocereals.ca for variety profiles. Plant into a well-prepared seed bed under good growing conditions. Use wheat in at least a 3-yr rotation since the disease can survive in wheat residue.	difenoconazole + metalaxyl-M	Dividend XL RTA	650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	tebuconazole + metalaxyl-M	Raxil MD	300 mL	For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provide good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
FUSARIUM spp. (SEED-BORNE, SEED ROT and SEEDLING BLIGHT)				
Seed Treatment			**per 100 kg seed**	
Infected seed is lightweight and shrivelled. Fungicide seed treatment is very effective against this disease. Other options include the use of tolerant varieties and disease-free seed. Consult with your seed company and the Ontario Cereal Crops Committee Variety Trial Results at www.gocereals.ca for variety profiles. Plant into a well-prepared seedbed under good growing conditions. Use wheat in at least a 3-yr rotation since the disease can survive in wheat residue. Avoid planting wheat after corn.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	tebuconazole + metalaxyl-M	Raxil MD	300 mL	For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder.
	ipconazole	Rancona Apex	325 mL	Do not graze or feed livestock on treated areas for 30 days after planting.
	fludioxonil	Proseed	5.2–10.4 mL	**For use in commercial seed treatment facilities only.** Use in combination with Dividend XL RTA for broad spectrum control.
SEEDLING DISEASES				
COMMON ROOT ROT (COMMON BLIGHT) (*Cochliobolus sativus*)				
Seed Treatment			**per 100 kg seed**	
Infected plants can be found individually or in irregular patches. These plants are often stunted and yellow (chlorotic) with a dark browning or blacking of the subcrown internodes. Drought and warm temperatures favour root rot. Maintain sound soil health practices and use good 3-yr crop rotation using non-host crops. Avoid soil compaction and deep seeding.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	**Provides suppression only.** For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	ipconazole	Rancona Apex	325 mL	**Provides suppression only.** Do not graze or feed livestock on treated areas for 30 days after planting.
	tebuconazole + thiram	Raxil T	225 mL	**Provides suppression only.** Do not graze or feed livestock on treated areas for 6 weeks after planting.
	tebuconazole + metalaxyl-M	Raxil MD	300 mL	**Provides suppression only.** For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	**Provides suppression only.** Do not graze or feed livestock on treated areas for 6 weeks after planting.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
FUSARIUM CROWN and FOOT ROT (*Fusarium graminearum, F. culmorum, F. pseudograminearum*)				
Seed Treatment			**per 100 kg seed**	
Cool, dry soils are favourable for disease development. Delay planting until conditions will result in a rapid and uniform emergence. Avoid planting after corn and maintain good soil fertility.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	**Provides suppression only.** For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	ipconazole	Rancona Apex	325 mL	**Provides suppression only.** Do not graze or feed livestock on treated areas for 30 days after planting.
	tebuconazole + metalaxyl-M	Raxil MD	300 mL	**Provides suppression only.** For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
PYTHIUM DAMPING-OFF (*Pythium* spp.)				
Seed Treatment			**per 100 kg seed**	
This disease can occur on all soil types but losses are greatest in cold, wet clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Seed treatments containing metalaxyl or metalaxyl-M can reduce infection. Delay planting until conditions will result in a rapid and uniform emergence.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	metalaxyl-M	Apron XL LS	20–40 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Read the label for information regarding resistant strains of fungus. Do not graze or feed livestock on seeded area for 4 weeks after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder.
	tebuconazole + metalaxyl-M	Raxil MD	300 mL	For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
PENICILLIUM (*Penicillium* spp.) and ASPERGILLUS SEED ROT (*Aspergillus* spp.)				
Seed Treatment			**per 100 kg seed**	
Both of these diseases are considered storage moulds. Their incidence increases when wheat is stored under warm temperatures and moist conditions. Seed that is damaged is especially susceptible under these conditions. Maintain grain at less than 14% moisture and below 20°C. Avoid damaging seed during harvest or handling.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	ipconazole	Rancona Apex	325 mL	Do not graze or feed livestock on treated areas for 30 days after planting.
DWARF BUNT (*Tilletia controversa*)				
Seed Treatment			**per 100 kg seed**	
Wheat infected with dwarf bunt will be substantially shorter than healthy plants. Infected seed has a "fishy" smell. Dwarf bunt occurs on winter wheat, primarily in counties bordering Georgian Bay and Lake Huron where snow cover is deep and persistent in late winter and early spring. Plant seed that is free of bunt spores (black). Treat seed when bunt has been observed in the crop. Cut the crop high when harvesting. Raising the header reduces the amount of bunt balls being harvested. Ensure good coverage of fungicide seed treatment on the seed. Avoid planting wheat in fields with soil-borne dwarf bunt for 5–7 yr, since the fungus is very persistent.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	**For control of seed-borne dwarf bunt only.** Do not graze or feed livestock on treated areas for 6 weeks after planting.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
LOOSE SMUT (*Ustilago tritici*)				
Seed Treatment			**per 100 kg seed**	
This fungus infects the embryo at flowering, thus is seed-borne. Light rains or heavy dew and moderate temperature, 15°C–16°C, during flowering, favour infection. Use pedigree seed that is treated with a fungicide seed treatment. This disease was quite important in Ontario wheat production, but the incidence and hence its impact has been reduced substantially due to the effectiveness of fungicide seed treatments. Good coverage of seed with fungicide seed treatment is important.	carbathiin + thiram	Vitaflo 280	330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	tebuconazole + metalaxyl-M	Raxil MD	300 mL	For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 55 days of planting.
	triadimenol	Baytan 30	50 mL	Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder.
	ipconazole	Rancona Apex	325 mL	Do not graze or feed livestock on treated areas for 30 days after planting.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
TAKE-ALL (*Gaeumannomyces graminis*)				
Seed Treatment			**per 100 kg seed**	
Carefully manage your soil fertility to manage this disease. Neutral to alkaline and infertile soils are most at risk. Do not apply lime before planting. Potassium and phosphorus deficiencies in the soil cause plants to be more susceptible because of poor root development. Nitrate nitrogen increases disease severity. Control grass weeds and avoid early planting. Use a 3-yr crop rotation and avoid planting wheat after wheat.	triadimenol	Baytan 30	100 mL	**Provides suppression only.** Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	**Provides suppression only.** For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 55 days of planting.
COMMON BUNT (*Tilletia tritici* and *Tilletia laevis*)				
Seed Treatment			**per 100 kg seed**	
Cool soil temperatures after seeding favours this disease. This disease was quite important in Ontario wheat production, but the incidence and hence its impact has been reduced substantially due to the effectiveness of fungicide seed treatments. Use seed that is free of bunt spores (black). Infected seed produces a "fishy" smell.	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	Controls both seed- and soil-borne common bunt. For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 55 days of planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	tebuconazole + metalaxyl-M	Raxil MD	300 mL	For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
	triadimenol	Baytan 30	50 mL	Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated seed. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder.
	ipconazole	Rancona Apex	325 mL	Do not graze or feed livestock on treated areas for 30 days after planting.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
FOLIAR, STEM and HEAD DISEASES (See Appendix J. *Cereal Growth Stages*, on page 136)				
EARLY-SEASON SEPTORIA (*Septoria* spp.)				
Seed Treatment			**per 100 kg seed**	
Early-season septoria control may reduce the risk of later infection. However, if the flag leaf is disease-free at the time of head emergence, a fungicide will not likely be necessary.	difenoconazole + metalaxyl-M	Dividend XL RTA	650 mL	Provides control for the first 6 weeks after planting. For full-season control, apply a foliar fungicide. For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeders. Do not graze, feed green forage or cut for hay within 55 days of planting.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
SEPTORIA LEAF SPOT (*Septoria tritici*)				
Foliar Treatment			**per ha (per acre)**	**PHI***
Wet, windy weather and moderate temperatures favour the development of this disease. Destroying volunteer wheat, reducing crop residue and crop rotation can help reduce risk of infection. Plant less susceptible varieties. Consult with your seed company and the Ontario Cereal Crops Committee Variety Trial Results at www.gocereals.ca for variety profiles. See Appendix J. *Cereal Growth Stages*, on page 136.	pyraclostrobin	Headline EC	300–600 mL (120–240 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
	azoxystrobin + propiconazole	Quilt	750 mL (305 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 1 application/yr. Do not harvest for forage. 12-hr re-entry period.
	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	45	Ground and aerial application. Early application at Zadok's 12–23. Use low rate for early-season disease suppression. Use higher rate for field with high disease pressure history or field conditions favourable for disease development. Later application at first sign of disease (Zadok's 29–37) or before head is half emerged (Zadok's 49–55). Apply only the high rate on any application from Zadok's 29–55. Maximum 2 applications/yr.
		Bumper 418 EC	150–300 mL (60–121 mL)	45	Ground and aerial application. For early-season disease suppression, use the lower rate at Zadok's 12–23 (as early as the two leaf stage). Use the high rate for fields with a history of disease pressure. For later-season application, apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Apply only the high rate from Zadok's 29–55. Maximum 2 applications/yr.
	prothioconazole	Proline 480 SC	315 mL (128 mL)	30	**Ground application only.** Use as a preventative when earliest disease symptoms appear on the leaves and stems. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Minimum 7-day interval between applications. Maximum 2 applications/yr. 24-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
SEPTORIA LEAF SPOT (*Septoria tritici*) cont'd					
Foliar Treatment (cont'd)			per ha (per acre)		
Wet, windy weather and moderate temperatures favour the development of this disease. Destroying volunteer wheat, reducing crop residue and crop rotation can help reduce risk of infection. Plant less susceptible varieties. Consult with your seed company and the Ontario Cereal Crops Committee Variety Trial Results at www.gocereals.ca for variety profiles. See Appendix J. *Cereal Growth Stages*, on page 136.	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	36	Ground and aerial application. Apply to leaf foliage at the first sign or very early stage of disease, especially if weather conditions are conducive to disease development, up to the end of the flowering stage. Use the higher rate when weather conditions are conducive to heavy disease development. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	220–292 mL (90–118 mL)	36	Ground and aerial application. Apply to leaf foliage at the first sign or very early stage of disease, especially if weather conditions are conducive to disease development, up to the end of the flowering stage. Use the higher rate when weather conditions are conducive to heavy disease development. Always use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.
	mancozeb	Dithane DG Rainshield NT	early: 1.1 kg (440 g) late: 2.25 kg (900 g)	40	Use lower rate for applications at Zadok's 12–21 growth stage, when crop is in 3rd leaf to tillering. Higher rate for applications at Zadok's 59 growth stage when head is fully emerged but prior to flowering. Do not graze crop or cut for hay. Maximum 2 applications/yr.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
POWDERY MILDEW (*Erysiphe graminis f. sp. tritici*)				
Seed Treatment			**per 100 kg seed**	
The fungus is very susceptible to weather conditions that promote drying of the crop environment, such as hot, dry, sunny weather. Management includes the use of tolerant varieties, crop rotation, tillage and fungicides. Consult with your seed company and the Ontario Cereal Crops Committee Variety Trial Results at www.gocereals.ca for variety profiles. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for thresholds and more information.	triadimenol	Baytan 30	50 mL 100 mL	Use higher rate for winter wheat. Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated seed. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
Foliar Treatment			**per ha (per acre)**	**PHI***
Foliar fungicide applications may be necessary if disease levels will result in yield losses and/or a susceptible variety has been used. Consult with your seed company and the Ontario Cereal Crops Committee Variety Trial Results at www.gocereals.ca for variety profiles. Thresholds for fungicide applications differ, depending on the age of the crop. If 5%–10% of the lower leaves are infested early in the season, control is warranted. This may limit later infection. Later in the season, powdery mildew symptoms on the flag leaf (1% of leaf) and the second leaf (3%–5% of the leaf) require immediate attention, especially if prolonged wet, humid weather is forecast. See Appendix J. *Cereal Growth Stages*, on page 136.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
	propiconazole	Tilt 250 E	500 mL (200 mL)	45	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply a second spray before the head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. Maximum 2 applications/yr.
		Bumper 418 EC	300 mL (121 mL)		

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
POWDERY MILDEW (*Erysiphe graminis f. sp. tritici*) cont'd					
Foliar Treatment (cont'd)			per ha (per acre)		
	tebuconazole	Folicur 250 EW	500 mL (200 mL)	36	Ground and aerial application. Apply to leaf foliage at the first sign or very early stage of disease, especially if weather conditions are conducive to disease development, up to the end of the flowering stage. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	292 mL (118 mL)	36	Ground and aerial application. Apply to leaf foliage at the first sign or very early stage of disease, especially if weather conditions are conducive to disease development, up to the end of the flowering stage. Use the higher rate when weather conditions are conducive to heavy disease development. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application.Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Can be tank-mixed with Buctril M in wheat. Maximum 2 applications/yr. 12-hr re-entry period.
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
RUST (LEAF — *Puccinia triticina* and STEM — *P. graminis f. sp. tritici*)			**per ha (per acre)**	**PHI***	
Leaf rust blows in from the southern U.S. late in the season. Minimize stem rust by removing its alternate host, common barberry. Use tolerant or resistant varieties to reduce risk of disease. There are many different phenotypes (races), and wheat varieties vary in their resistance/ tolerance. The development of new races could result in a once-resistant variety becoming susceptible over time. Consult with your seed company and the Ontario Cereal Crops Committee Variety Trial Results at www.gocereals.ca for variety profiles. Use foliar treatments when flag leaf has 5–10 pustules (1% leaf area). See Appendix J. *Cereal Growth Stages*, on page 136.	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	36	Ground and aerial application. Apply to leaf foliage at the first sign or very early stage of disease, especially if weather conditions are conducive to disease development, up to the end of the flowering stage. Use the higher rate when weather conditions are conducive to heavy disease development. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	220–292 mL (90–118 mL)	36	Ground and aerial application. Apply to leaf foliage at the first sign or very early stage of disease, especially if weather conditions are conducive to disease development, up to the end of the flowering stage. Use the higher rate when weather conditions are conducive to heavy disease development. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.
	pyraclostrobin	Headline EC	300–600 mL (121–240 mL)	Do not apply at boot stage and beyond.	**For leaf rust control only.** Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. When expecting high disease pressure from stripe rust and wheat leaf rust, use the higher application rate of 1 L/ha. Do not harvest for forage. Maximum 1 application/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
RUST (LEAF — *Puccinia triticina* and STEM — *P. graminis f. sp. tritici*)			**per ha (per acre)**		
	propiconazole	Tilt 250 E	500 mL (200 mL)	45	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. Maximum 2 applications/yr.
		Bumper 418 EC	300 mL (121 mL)		
	prothioconazole	Proline 480 SC	315 mL (128 mL)	30	**Ground application only.** Use as a preventative when earliest disease symptoms appear on the leaves and stems. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Mimimum 7-day interval between applications. Maximum 2 applications/yr. 24-hr re-entry period.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Can be tank-mixed with Buctril M in wheat. Maximum 2 applications/yr. 12-hr re-entry period.
	mancozeb	Dithane DG Rainshield NT	early: 1.1 kg (440 g) late: 2.25 kg (900 g)	40	**For leaf rust control only.** Use lower rate for applications at Zadok's 12–21 growth stage, when crop is in 3rd leaf to tillering. Higher rate for applications at Zadok's 59 growth stage when head is fully emerged but prior to flowering. Do not graze crop or cut for hay. Maximum 2 applications/yr.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
TAN SPOT (*Pyrenophora tritici-repentis*)			per ha (per acre)	PHI*	
Reduced tillage and cool, cloudy, humid weather promotes this disease. Tan spot survives in crop residues. Avoid planting wheat in conservation tillage fields in which wheat was grown during the preceding 2 yr.	pyraclostrobin	Headline EC	300–600 mL (121–240 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
See Appendix J. *Cereal Growth Stages*, on page 136.	azoxystrobin + propiconazole	Quilt	750 mL (305 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Do not harvest for forage. Maximum 1 application/yr. 12-hr re-entry period.
	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	45	Ground and aerial application. Early application at Zadok's 12–23. Use low rate for early-season disease suppression. Use higher rate for field with high disease pressure history or field conditions favourable for disease development. Later application at first sign of disease (Zadok's 29–37) or before head is half emerged (Zadok's 49–55). Apply only the high rate on any application from Zadok's 29–55. Maximum 2 applications/yr.
		Bumper 418 EC	150–300 mL (60–121 mL)	45	Ground and aerial application. For early-season disease suppression, use the lower rate at Zadok's 12–23 (as early as the two leaf stage). Use the high rate for field with a history of disease pressure. For later-season application, apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Apply only the high rate from Zadok's 29–55. Maximum 2 applications/yr.
	prothioconazole	Proline 480 SC	315 mL (128 mL)	30	**Ground application only.** Use as a preventative when earliest disease symptoms appear on the leaves and stems. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Mimimum 7-day interval between applications. Maximum 2 applications/yr. 24-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
TAN SPOT (*Pyrenophora tritici-repentis*) cont'd			**per ha (per acre)**		
	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	36	Ground and aerial application. Apply to leaf foliage at the first sign or very early stage of disease, especially if weather conditions are conducive to disease development, up to the end of the flowering stage. Use the higher rate when weather conditions are conducive to heavy disease development. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	220–292 mL (90–118 mL)	36	Ground and aerial application. Apply to leaf foliage at the first sign or very early stage of disease, especially if weather conditions are conducive to disease development, up to the end of the flowering stage. Use the higher rate when weather conditions are conducive to heavy disease development. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Can be tank-mixed with Buctril M in wheat. Maximum 2 applications/yr. 12-hr re-entry period.
	mancozeb	Dithane DG Rainshield NT	early: 1.1 kg (440 g) late: 2.25 kg (900 g)	40	Use lower rate for applications at Zadok's 12–21 growth stage, when crop is in 3rd leaf to tillering. Higher rate for applications at Zadok's 59 growth stage when head is fully emerged but prior to flowering. Do not graze crop or cut for hay. Maximum 2 applications/yr.
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
FUSARIUM HEAD BLIGHT (*Fusarium graminearum*)			per ha (per acre)		
Warm and prolonged wet conditions during flowering are necessary for infection to occur. Avoid planting into corn stubble, since the fungus also causes gibberella stalk rot in corn. Follow soybeans with wheat in the rotation. See the *Fusarium* forecasting web page at www.weatherinnovations.com/DONcast.cfm to determine the fusarium head blight risk for your area and for current recommendations. Consult your local crop advisor for forecast information.	metconazole	Caramba	1 L (0.4 L)	30	**Provides suppression only.** Ground and aerial application. Timing of application is critical. Apply at 20% flowering (Zadok's 61–63) using sprayer nozzles configured to provide excellent coverage of the cereal head. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. **5-day re-entry period.**
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	**Provides suppression only.** Ground and aerial application. Timing of application is critical. Apply as a preventative spray within the time period from when at least 75% of the wheat head on the main stem are fully emerged (Zadok's 59) to when 50% of the heads on the main stem are in flower (Zadok's 65). Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.
See Appendix J. *Cereal Growth Stages*, on page 136.	prothioconazole	Proline 480 SC	315–420 L (128–170 mL)	30	**Provides suppression only. Ground application only.** Timing of application is critical. Apply from when at least 75% of the wheat heads on main stem are fully emerged (Zadok's 59) to when 50% of the heads on the main stem are in flower (Zadok's 65). Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr (735 mL/ha) with a minimum 7-day interval between applications. 24-hr re-entry period.
	tebuconazole	Folicur 250 EW	500 mL (200 mL)	36	**Provides suppression only.** Ground and aerial application. Timing of application is critical. The optimum window for application is 1–4 days after 75% of the heads have emerged or cleared the head (Day 0). Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.
		Folicur 432 F	292 mL (118 mL)	36	**Provides suppression only.** Ground and aerial application. Timing of application is critical. The optimum window for application is 1–4 days after 75% of the heads have emerged or cleared the head (Day 0). Ensure thorough coverage of all wheat heads. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
STAGONOSPORA GLUME BLOTCH (*Stagonospora nodorum*)			per ha (per acre)	PHI*	
Prolonged wet periods in May and early June result in increased disease incidence. Rotate with crops other than cereals, plow down cereal residues and remove volunteer wheat to reduce survivability of the fungi. See Appendix J. *Cereal Growth Stages*, on page 136.	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.
	prothioconazole	Proline 480 SC	315–420 mL (128–170 mL)	30	**Ground application only.** Timing of application is critical. Apply from when at least 75% of the wheat heads on the main stem are fully emerged (Zadok's 59) to when 50% of the heads on the main stem are in flower (Zadok's 65). Use higher rate when expecting high disease pressure. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr (735 mL/ha) with a minimum 7-day interval between applications. 24-hr re-entry period.
	tebuconazole	Folicur 250 EW	500 mL (200 mL)	36	Ground and aerial application. Apply from when at least 75% of the wheat heads on the main stem are fully emerged (Zadok's 59) to when 50% of the heads on the main stem are in flower (Zadok's 65). The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	292 mL (18 mL)	36	Ground and aerial application. Apply from when at least 75% of the wheat heads on the main stem are fully emerged (Zadok's 59) to when 50% of the heads on the main stem are in flower (Zadok's 65). Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
	chlorothalonil	Bravo 500	1.5–2.5 mL (0.6–1.0 L)	30	Ground and aerial application. Apply at Zadok's growth stage 37 (flag leaf emergence) and repeat 10–14 days later at growth stage 51–55 (visible ear). A 3rd application at growth stage 59–69 (ear fully emerged) may be necessary if conditions favour disease spread. Maximum 3 applications/yr.

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
STAGONOSPORA GLUME BLOTCH (*Stagonospora nodorum*) cont'd			**per ha (per acre)**	**PHI***	
	propiconazole	Tilt 250 E	500 mL (200 mL)	45	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. Maximum 2 applications/yr.
		Bumper 418 EC	300 mL (121 mL)		
STRIPE RUST (*Puccinia striiformis*)			**per ha (per acre)**	**PHI***	
Stripe rust can be confused with Cephalosporium stripe since both will produce a yellow striping (interveinal) that can extend the entire length of the leaf. If rust is the cause, orange-yellow pustules (blisters) can be found, whereas no blistering is found in Cephalosporium stripe. This disease is most noticeable in seasons with a prolonged cool spring (3°C–15°C). Symptoms often disappear as temperatures increase.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Use higher application rate of 1 L/ha when expecting high disease pressure from stripe rust and wheat leaf rust. Maximum 1 application/yr. Do not harvest for forage. 12-hr re-entry period.
	propiconazole	Tilt 250 E	500 mL (200 mL)	45	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. Maximum 2 applications/yr.
		Bumper 418 EC	300 mL (121 mL)		

* PHI = Pre-Harvest Interval (days)

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
STRIPE RUST (*Puccinia striiformis*) cont'd			**per ha (per acre)**	**PHI***	
	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	36	Ground and aerial application. Apply to leaf foliage at the first sign or very early stage of disease, especially if weather conditions are conducive to disease development, up to the end of the flowering stage. Use the higher rate when weather conditions are conducive to heavy disease development. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	220–292 mL (90–118 mL)	36	Ground and aerial application. Apply to leaf foliage at the first sign or very early stage of disease, especially if weather conditions are conducive to disease development, up to the end of the flowering stage. Use the higher rate when weather conditions are conducive to heavy disease development. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Can be tank-mixed with Buctril M in wheat. Maximum 2 applications/yr. 12-hr re-entry period.
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–4. Barley Seed and Soil-Applied Fungicide Recommendations

Active Ingredient	Products	Formulation	Barley Diseases		
			Seed and Seedling Blight	Covered Smut	True Loose Smut
carbathiin + thiram	Vitaflo 280	F	+	+	+
difenoconazole + metalaxyl-M	Dividend XL RTA	F	+	+	+
ipconaxole	Rancona Apex	F	+	+	+
tebuconazole + metalaxyl	Raxil MD	F	+	+	+
tebuconazole + thiram	Raxil T	F	+	+	+
triadimenol	Baytan 30	F	—	+	+
triticonazole + thiram	Gemini	F	+	+	+

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable P = Powder

+ = Recommended for disease listed — = Not Recommended

Table 4–5. Oat Seed and Soil-Applied Fungicide Recommendations

Active Ingredient	Products	Formulation	Oat Diseases			
			Seedling Blight	Covered Smut	True Loose Smut	Pythium
carbathiin + thiram	Vitaflo 280	F	+	+	+	+
difenoconazole + metalaxyl-M	Dividend XL RTA	F	+	+	+	+
ipconaxole	Rancona Apex	F	+	+	+	—
tebuconazole + metalaxyl	Raxil MD	F	+	+	+	+
tebuconazole + thiram	Raxil T	F	—	+	+	—
triticonazole + thiram	Gemini	F	—	+	+	—

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable P = Powder

+ = Recommended for disease listed — = Not Recommended

Table 4–6. Rye Seed and Soil-Applied Fungicide Recommendations

Active Ingredient	Products	Formulation	Rye Diseases				
			Seedling Blight	Seed-Borne Septoria	Common Bunt	Dwarf Bunt	Pythium Damping-Off
carbathiin + thiram	Vitaflo 280	F	+	—	—	—	+
difenoconazole + metalaxyl-M	Dividend XL RTA	F	+	+	+	+	+
ipconaxole	Rancona Apex	F	+	—	—	—	—

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable P = Powder

+ = Recommended for disease listed — = Not Recommended

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
BARLEY				
SEED and SEEDLING DISEASES				
SEED ROT and SEEDLING BLIGHT				
Seed Treatment			**per 100 kg seed**	
Ensure good coverage of seed treatment on the seeds. Rotation with non-host crops for at least 2 yr will reduce risk of disease. Avoid deep seeding.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	tebuconazole + metalaxyl	Raxil MD	300 mL	For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder.
	ipconazole	Rancona Apex	325 mL	Do not graze or feed livestock on treated areas for 30 days after planting.
COCHLIOBOLUS SEEDLING BLIGHT (*Cochliobolus sativus*)				
Seed Treatment			**per 100 kg seed**	
Avoid frequent or continuous barley crops in a rotation. Avoid deep seeding. Turn under crop stubble to help reduce infection levels. Plant resistant varieties. Consult with your seed company and the Ontario Cereal Crops Committee Variety Trial Results at www.gocereals.ca for variety profiles.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	tebuconazole + metalaxyl	Raxil MD	300 mL	**Provides suppression only.** For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
	ipconazole	Rancona Apex	325 mL	Do not graze or feed livestock on treated areas for 30 days after planting.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
COVERED SMUT (COMMON BUNT) (*Ustilago hordei*)				
Seed Treatment			**per 100 kg seed**	
Infection can occur at temperatures of 14°C–25°C, especially when the soil moisture levels are high. Seed treatment is the primary method of control.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	tebuconazole + metalaxyl	Raxil MD	300 mL	For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
	triadimenol	Baytan 30	50 mL	**For use in spring barley only.** Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated seed. Do not graze or feed livestock on treated areas for 40 days after planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	triticonazole + thriam	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder.
	ipconazole	Rancona Apex	325 mL	Do not graze or feed livestock on treated areas for 30 days after planting.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
LOOSE SMUT (*Ustilago nuda*)				
Seed Treatment			**per 100 kg seed**	
Infection occurs during flowering. Conditions that promote the disease are wet, cloudy weather and moderate temperatures 16°C–22°C. Sow pedigree seed to ensure that seed is not infected. Moist weather at flowering promotes this disease. Disease incidence has been increasing in Ontario where no seed treatment has been used. Seed treatments are beneficial in reducing loose smut infection.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	tebuconazole + metalaxyl	Raxil MD	300 mL	For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
	triadimenol	Baytan 30	50 mL	Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated seed. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder.
	ipconazole	Rancona Apex	325–433 mL	Use higher rate for highly infected seed lots only. Do not graze or feed livestock on treated areas for 30 days after planting.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate		Comments (label precautions, re-entry periods, etc.)
FOLIAR, STEM and HEAD DISEASES					
NET BLOTCH (*Pyrenophora teres*)			**per ha (per acre)**	**PHI***	
Avoid growing barley after barley, wheat or grasses in a rotation. Plow down stubble and straw and plant early to avoid serious disease in July.	pyraclostrobin	Headline EC	300–600 mL (121–240 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
	azoxystrobin + propiconazole	Quilt	750 mL	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 1 application/yr. Do not harvest for forage. 12-hr re-entry period.
	prothioconazole	Proline 480 SC	210–315 mL (85–128 mL)	30	**Ground application only.** Use as a preventative treatment when earliest disease symptoms appear on the leaves and stems. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr with a minimum 7-day interval between applications. 24-hr re-entry period.
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.
	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	36	Ground and aerial application. Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	220–292 mL (90–118 mL)	36	Ground and aerial application. Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
NET BLOTCH (*Pyrenophora teres*) cont'd			**per ha (per acre)**	**PHI***	
	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	45	Ground and aerial application. Early application at Zadok's 12–23. For early-season disease suppression, use low rate. Use higher rate for field with high disease pressure history or field conditions favourable for disease development. Use for later application at first sign of disease (Zadok's 29–37) or before head is half emerged (Zadok's 49–55). Apply only the high rate on any application from Zadok's 29–55. Maximum 2 applications/yr.
		Bumper 418 EC	150–300 mL (60–121 mL)	45	**For use in spring barley only.** Ground and aerial application. For early-season disease suppression, use the lower rate at Zadok's 12–23 (as early as the two-leaf stage). Use the high rate on fields with a history of disease pressure. For later-season application, apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Apply only the high rate from Zadok's 29–55. Maximum 2 applications/yr.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Do not apply at boot stage and beyond.	**For use in spring barley only.** Ground and aerial application. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
SPOT BLOTCH (*Cochliobolus sativus*)			**per ha (per acre)**	**PHI***	
Avoid growing barley after barley, wheat or grasses in a rotation. Plow down stubble and straw and plant early to avoid serious disease in July.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
	prothioconazole	Proline 480 SC	210–315 mL (85–128 mL)	30	**Ground application only.** Use as a preventative treatment when earliest disease symptoms appear on the leaves and stems. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr with a minimum 7-day interval between applications. 24-hr re-entry period.
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate per ha (per acre)	PHI*	Comments (label precautions, re-entry periods, etc.)
SPOT BLOTCH (*Cochliobolus sativus*) cont'd					
	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	36	Ground and aerial application. Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	220–292 mL (90–118 mL)	36	Ground and aerial application. Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
	propiconazole	Tilt 250 E	500 mL (200 mL)	45	**For use in spring barley only.** Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadoks 49–55). Maximum 2 applications/yr.
		Bumper 418 EC	300 mL (121 mL)		
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Do not apply at boot stage and beyond.	**For use in spring barley only.** Ground and aerial application. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
SCALD (*Rhynchosporium secalis*)			**per ha (per acre)**	**PHI***	
Avoid growing barley after barley, wheat or grasses in a rotation. Plow down stubble and straw and plant early to avoid serious disease in July.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
	azoxystrobin + propiconazole	Quilt	750 mL (305 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Do not apply at boot stage and beyond. Maximum 1 application/yr. Do not harvest for forage. 12-hr re-entry period.
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.
	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	36	Ground and aerial application. Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	220–292 mL (90–118 mL)	36	Ground and aerial application. Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
SCALD (*Rhynchosporium secalis*) cont'd			**per ha (per acre)**	**PHI***	
	propiconazole	Tilt 250 E	500 mL (200 mL)	45	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank-mixed with several cereal herbicides.
		Bumper 418 EC	300 mL (121 mL)	45	**For use in spring barley only.** Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Maximum 2 applications/yr.
	prothioconazole	Proline 480 SC	210–315 mL (85–128 mL)	30	**Ground application only.** Use as a preventative when earliest disease symptoms appear on the leaves and stems. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr with a minimum 7-day interval between applications. 24-hr re-entry period.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Do not apply at boot stage and beyond.	**For use in spring barley only.** Ground and aerial application. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
SEPTORIA LEAF SPOT (*Septoria tritici*)			**per ha (per acre)**	**PHI***	
Avoid growing barley after barley, wheat or grasses in a rotation. Plow-down stubble and straw and plant early to avoid serious disease in July.	azoxystrobin + propiconazole	Quilt	750 mL (305 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Do not apply at boot stage and beyond. Maximum 1 application/yr. Do not harvest for forage. 12-hr re-entry period.
	propiconazole	Tilt 250 E	500 mL (200 mL)	45	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged.
		Bumper 418 EC	300 mL (121 mL)	45	**For use in spring barley only.** Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Maximum 2 applications/yr.
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.
	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	36	Ground and aerial application. Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	220–292 mL (90–118 mL)	36	Ground and aerial application. Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Do not apply at boot stage and beyond.	**For spring barley only.** Ground and aerial application. Do not apply second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
RUST (LEAF — *Puccinia hordei*, STEM — *Puccinia graminis f. sp. tritici*)			**per ha (per acre)**	**PHI***	
Leaf rust spores are blown in from the south, and in most years, late-planted fields are most likely to show the disease. The alternate host is barberry. Remove or destroy alternate host from fence rows, etc. Plant early to reduce risk of disease incidence.	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	36	Ground and aerial application. Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	220–292 mL (90–118 mL)	36	Ground and aerial application. Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.
	azoxystrobin + propiconazole	Quilt	1.0 L (406 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Use higher application rate of 1 L/ha when expecting high disease pressure from stripe rust and wheat leaf rust. Maximum 1 application/yr. Do not harvest for forage. 12-hr re-entry period.
	propiconazole	Tilt 250 E	500 mL (200 mL)	45	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged.
		Bumper 418 EC	300 mL (121 mL)	45	**For use in spring barley only.** Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Maximum 2 applications/yr.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
POWDERY MILDEW (*Erysiphe graminis*)			per ha (per acre)		
Foliar fungicide applications may be necessary if disease levels will result in yield losses and a susceptible variety has been used. Consult with your seed company and the Ontario Cereal Crops Committee Variety Trial Results at www.gocereals.ca for variety profiles.	propiconazole	Bumper 418 EC	300 mL (121 mL)	45	**For use in spring barley only.** Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Maximum 2 applications/yr.
	tebuconazole	Folicur 250 EW	375–500 mL (152–200 mL)	36	Ground and aerial application. Apply to leaf foliage at the first sign or very early stage of disease, especially if weather conditions are conducive to disease development, up to the end of the flowering stage. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	220–292 mL (90–118 mL)	36	Ground and aerial application. Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
FUSARIUM HEAD BLIGHT (*Fusarium graminearum*)			per ha (per acre)	PHI*	
Fusarium head blight infection in barley is often not as noticeable as in wheat, so examine developing heads carefully for bleached or tan spikelets. Avoid planting barley into corn residue. For more information, see *FUSARIUM HEAD BLIGHT (Fusarium graminearum)*, on page 60.	metconazole	Caramba	1 L (0.4 L)	30	**Provides suppression only.** Ground and aerial application. Timing of application is critical. Apply at 20% flowering (Zadok's 61–63) using sprayer nozzles configured to provide excellent coverage of the cereal head. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. **5-day re-entry period.**
	prothioconazole + tebuconazole	Prosaro 250 EC	800 mL (324 mL)	36	**Provides suppression only.** Ground and aerial application. Timing of application is critical. For optimum suppression, apply as a preventive spray from when 70%–100% of the barley main stem heads are fully emerged to 3 days after full head emergence. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period.
	prothioconazole	Proline 480 SC	315–420 mL (128–170 mL)	30	**Provides suppression only.** Timing is critical. For optimum suppression, apply as a preventive spray from when 70%–100% of the barley main stem heads are fully emerged to 3 days after full head emergence. Maximum 2 applications/yr (735 mL/ha) with a minimum 7-day interval between applications. 24-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
OAT				
SEED and SEEDLING DISEASES				
SEED ROT and SEEDLING BLIGHT (*Pyrenopora avenae, Fusarium* spp. and others)				
Seed Treatment			**per 100 kg seed**	
Ensure good coverage of seed treatment on seeds. Rotation with non-host crops for at least 2 yr will reduce risk. Use disease-free seed and avoid deep seeding.	carbathiin + thiram	Vitaflo 280	330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	ipconazole	Rancona Apex	325 mL	Do not graze or feed livestock on treated areas for 30 days after planting.
	tebuconazole + metalaxyl-M	Raxil MD	300 mL	For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
COVERED SMUT (COMMON BUNT) (*Ustilago kolleri*), LOOSE SMUT (*Ustilago avenae*)				
Seed Treatment			**per 100 kg seed**	
This disease is spread from year to year primarily through infected seed. Wind-blown spores will infect florets within season. Use pedigree seed that is treated with a fungicide seed treatment.	carbathiin + thiram	Vitaflo 280	330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist type seed treatment equipment. May also be used in treat-on-the-go seeder.
	tebuconazole + thiram	Raxil T	225 mL	**For loose smut control only.** Do not graze or feed livestock on treated areas for 4 weeks after planting.
	tebuconazole + metalaxyl-M	Raxil MD	300 mL	For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
	ipconazole	Rancona Apex	325 mL	Do not graze or feed livestock on treated areas for 30 days after planting.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
PYTHIUM DAMPING-OFF (*Pythium* spp.)			**per 100 kg seed**	
This disease can occur on all soil types but losses are greatest in cold, wet clay soils. Minimize soil compaction and remove excess moisture through improved drainage. Seed treatments containing metalaxyl-M can reduce infection. Delay planting until conditions will result in a rapid and uniform emergence.	carbathiin + thiram	Vitaflo 280	330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	tebuconazole + metalaxyl-M	Raxil MD	300 mL	For both commercial seed treatment plants and on-farm treatment with conventional seed treating equipment that can accurately control application rates and provides good distribution of chemical onto the seed in the mixing chamber. Uniform application is necessary to ensure seed safety and best disease control. Do not graze or feed livestock on treated areas for 4 weeks after planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
LEAF, STEM and HEAD DISEASES				
SEPTORIA LEAF SPOT (*Septoria tritici*)			**per ha (per acre)**	**PHI***
Avoid planting oat after oat or mixed grains. Humid, wet, windy weather promotes this disease.	propiconazole	Tilt 250 E	500 mL (200 mL)	45	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged.
		Bumper 418 EC	300 mL (121 mL)	45	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. Maximum 2 applications/yr.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
CROWN (LEAF) RUST (*Puccinia coronata* var. *avenae*)			per ha (per acre)		
European buckthorn is the alternate host for this disease. Remove or destroy buckthorn where possible. Crown rust can be a problem in central and eastern Ontario. Use resistant oat varieties. Consult with your seed company and the Ontario Cereal Crops Committee Variety Trial Results at www.gocereals.ca for variety profiles. Plant oat early to allow plants to mature before inoculum levels are high. Observe fields closely for early disease symptoms, particularly when susceptible varieties are planted and/or under prolonged conditions that favour disease development. These conditions include mild-to-warm temperatures (20°C–25°C) during the day and mild temperatures at nights (15°C–20°C) with adequate moisture (rains, frequent dews).	tebuconazole	Folicur 250 EW	375 mL (152 mL)	36	Ground and aerial application. Apply to leaf foliage at the first sign or very early stage of disease, especially if weather conditions are conducive to disease development, up to the end of the flowering stage. The use of a non-ionic surfactant (Agral 90 or Agsurf) is NOT required as it is built into the formulation. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
		Folicur 432 F	220 mL (90 mL)	36	Ground and aerial application. Apply at the very early stages of disease development. Use higher rate when disease pressure is severe. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Use a minimum of 100 L/ha of water for ground application, 47 L/ha of water for aerial application. Maximum 1 application/yr. 12-hr re-entry period. Before using Folicur for control of leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for *Fusarium* control, where applications are targeted at head emergence.
	propiconazole	Tilt 250 E	500 mL (200 mL)	45	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged.
		Bumper 418 EC	300 mL (121 mL)	45	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Maximum 2 applications/yr.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
	pyraclostrobin	Headline EC	300–400 mL (121–160 mL)	Do not apply at boot stage and beyond.	Ground and aerial application. For optimal disease control, apply immediately after flag leaf emergence (Zadok's 37). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
	prothioconazole	Proline 480 SC	260 mL (105 mL)	30	**Ground application only.** Apply as a preventative treatment when the earliest disease symptoms appear on the leaves and stems. Apply with a non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. Minimum of 7 days application interval. Maximum 2 applications/yr. 24-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
FUSARIUM HEAD BLIGHT (*Fusarium graminearum*)			per ha (per acre)		
For information on this disease, see *FUSARIUM HEAD BLIGHT (Fusarium graminearum)*, on page 60.	metconazole	Caramba	1 L (0.4 L)	30	**Provides suppression only.** Ground and aerial application. Timing of application is critical. Apply at 20% flowering (Zadok's 61–63) using sprayer nozzles configured to provide excellent coverage of the cereal head. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. **5-day re-entry period.**
RYE					
SEEDLING BLIGHT (*Pythium* spp., *Rhizoctonia* spp., *Fusarium* spp.)					
Seed Treatment			per 100 kg seed		
Sow into a well-prepared seed bed under good growing conditions. Avoid cool, wet conditions that will reduce emergence and increase seed rots and blights. Treat seed with a fungicide seed treatment.	carbathiin + thiram	Vitaflo 280	230–330 mL		Do not graze or feed livestock on treated areas for 4 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL		For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	ipconazole	Rancona Apex	325 mL		**For *Fusarium* control only.** Do not graze or feed livestock on treated areas for 30 days after planting.
PYTHIUM DAMPING-OFF (*Pythium* spp.)					
Seed Treatment			per 100 kg seed		
Sow into a well-prepared seed bed under good growing conditions. Avoid cool, wet conditions that will reduce emergence and increase seed rots and blights. Treat seed with a fungicide seed treatment.	carbathiin + thiram	Vitaflo 280	230–330 mL		Do not graze or feed livestock on treated areas for 4 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL		For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
SEED-BORNE SEPTORIA (*Septoria* spp.)					
Seed Treatment			per 100 kg seed		
Sow into a well-prepared seed bed under good growing conditions. Avoid cool, wet conditions that will reduce emergence and increase seed rots and blights. Treat seed with a fungicide seed treatment.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL		For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.

* PHI = Pre-Harvest Interval (days)

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
COMMON BUNT (*Tilletia caries*), DWARF BUNT (*Tilletia controversa*)				
Seed Treatment			**per 100 kg seed**	
Sow into a well-prepared seed bed under good growing conditions. Avoid cool, wet conditions that will reduce emergence and increase seed rots and blights. Treat seed with a fungicide seed treatment.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
LEAF RUST (*Puccinia recondita f.* sp. *recondita*)				
Foliar Treatment			**per ha (per acre)**	**PHI***
Leaf rust in rye is caused by the same fungus that infects wheat. See *RUST (LEAF — Puccinia triticina and STEM — P. graminis f. sp. tritici)*, on page 56, for management options and details.	pyraclostrobin	Headline EC	300–600 mL (120–240 mL)	Do not apply at boot stage and beyond. Ground and aerial application. For optimal disease control, apply immediately after flag leaf emergence (Zadok's 37). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
POWDERY MILDEW (*Erysiphe graminis f.* sp. *secalis*)			**per ha (per acre)**	**PHI***
In most cases, powdery mildew has little impact on rye since the crop is very resistant to the disease.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Do not apply at boot stage and beyond. Ground and aerial application. For optimal disease control, apply immediately after flag leaf emergence (Zadok's 37). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr. 12-hr re-entry period.
FUSARIUM HEAD BLIGHT (*Fusarium graminearum*)			**per ha (per acre)**	**PHI***
Fusarium head blight infection in oat is very difficult to identify. Bleached florets are often caused by high temperatures rather than *Fusarium*. Examine developing panicles carefully for any development of pink colouration. Avoid planting oat into corn residue. For more information, see *FUSARIUM HEAD BLIGHT (Fusarium graminearum)*, on page 60.	metconazole	Caramba	1 L (0.4 L)	30 **Provides suppression only.** Ground and aerial application. Timing of application is critical. Apply at 20% flowering (Zadok's 61–63) using sprayer nozzles configured to provide excellent coverage of the cereal head. Use a minimum of 100 L/ha of water for ground application, 50 L/ha of water for aerial application. Maximum 1 application/yr. **5-day re-entry period.**

* PHI = Pre-Harvest Interval (days)

5. Dry Edible Beans

DRY EDIBLE BEAN INSECTS

Table 5–1. Chemical Control Options for Insects in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
SEEDCORN MAGGOT (*Delia platura*)					
Seed Treatment			**per 100 kg seed**		
Seedcorn maggot problems in dry beans are rare in Ontario. Risk factors include cool, wet springs when germination is delayed. In fields at high risk, including early-planted fields where large amounts of manure, green manure or residue have recently been incorporated, use Cruiser seed treatment.	thiamethoxam	Cruiser 5FS	50–83 mL		**For use in commercial seed treatment facilities only.** Use higher rate when expecting high insect populations. May be mixed with Apron Maxx RTA for control of seed and soil-borne pathogens. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL		**For use in commercial seed treatment facilities only.** Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg seed. Do not graze or feed livestock on treated areas for 45 days after planting.
	diazinon + captan + thiophanate-methyl	DCT	1 L of slurry		Available in a 400-g container that will treat 77 kg of dry bean seed. Use full rate and ensure good coverage by applying as a slurry. To make slurry, use 520 g seed treatment/L of water.
MEXICAN BEAN BEETLE (*Epilachna varivestis*)			**per ha (per acre)**	**PHI***	
Mexican bean beetles are less of a problem in very hot, dry summers. Early-maturing bean varieties may be grown with little or no injury. Several natural enemies help keep populations below action thresholds. Insecticides are only recommended if populations are extremely high, as they will also kill the natural enemy population. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information.	dimethoate	Cygon 4 E	0.7–1.0 L (280–400 mL)	7	Do not feed treated threshings or crop refuse to livestock.
		Lagon 480 EC	0.7–1.0 L (280–400 mL)		
	endosulfan	Thiodan 4 EC	1.5–2.5 L (0.6–1.0 L)	2	Do not feed treated threshings or crop refuse to livestock. Do not use on lima beans.
		Thionex EC	1.5–2.5 L (0.6–1.0 L)		
		Thionex 50 WP	1.1–1.5 kg (400–600 g)		

* PHI = Pre-Harvest Interval (days)

DRY EDIBLE BEAN INSECTS

Table 5–1. Chemical Control Options for Insects in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
POTATO LEAFHOPPER (*Empoasca fabae*)					
Seed Treatments			per 100 kg seed		
Consider using insecticide seed treatment on fields with a history of leafhopper infestations, to reduce the number of foliar applications required. Insecticide seed treatments last at least 4–6 weeks after planting, eliminating the need for at least one foliar insecticide application.	thiamethoxam	Cruiser 5FS	86–143 mL		**For use in commercial seed treatment facilities only.** Use higher rate when expecting high insect populations. May be mixed with Apron Maxx RTA for control of seed and soil-borne pathogens. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL		**For use in commercial seed treatment facilities only.** Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg seed. Do not graze or feed livestock on treated areas for 45 days after planting.
Foliar Treatment			per ha (per acre)	PHI*	
Some tolerant varieties are available. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for action threshold charts and sampling methods.	dimethoate	Cygon 480 EC	0.7–1.0 L (280–400 mL)	7	Some residual activity is expected from this product. Ground or aerial application. Do not feed treated threshings or crop refuse to livestock. Maximum 3 applications/yr.
		Lagon 480 EC	0.7–1.0 L (280–400 mL)		
	endosulfan	Thiodan 4 EC	1.5–2.5 L (0.6–1.0 L)	2	**Ground application only.** Do not feed treated threshings or crop refuse to livestock. Do not use on lima beans.
		Thionex EC	1.5–2.5 L (0.6–1.0 L)		
		Thionex 50 WP	1.1–1.5 kg (400–600 g)		
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	21	This product has no systemic activity. Ground and aerial application. For best results, apply during the early morning, before temperatures rise, and during the evening. Use 100–200 L of water/ha for ground application. Use 20 L of water/ha for aerial applications. Do not graze or feed on treated forage. Maximum 3 applications/yr. 24-hr re-entry period.
		Silencer 120 EC	83 mL (34 mL)	14	This product has no systemic activity. **Ground application only.** For best results, apply during the early morning, before temperatures rise, and during the evening. Do not graze or harvest treated forage, straw or hay for livestock feed. Maximum 3 applications/yr. 24-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

DRY EDIBLE BEAN INSECTS

Table 5–1. Chemical Control Options for Insects in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
WESTERN BEAN CUTWORM (*Striacosta albicosta*)			per ha (per acre)	PHI*	
Larvae mine into the pod, feeding directly on the seed. Their entry holes also allow for the introduction of pod diseases. All these activities have a negative impact on yield, seed quality and increase pick. It is difficult to scout for WBC eggs or larvae in dry beans. Use pheromone traps instead to monitor for presence and peak flight. If pod feeding is easily found, spray is necessary. Apply insecticide 10–20 days after peak moth flight when larval feeding is expected. Additional information on pest status and management recommendations are provided at the Ontario WBC Trap Network: www.cornpest.ca/default/index.cfm/wbc-trap-network/	cyhalothrin-lambda	Matador 120 E	83–187 mL (34–76 mL)	21	Ground or aerial application. For best results, apply in the early morning, before temperatures rise, or during the evening. Use 100–200 L water/ha for ground application, 20 L water/ha for aerial application. Spray no later than 10 days after egg hatch. Maximum 3 applications/yr. Do not make more than 2 applications of 83 mL/ha by air. 24-hr re-entry period.
TARNISHED PLANT BUG (*Lygus lineolaris*) and *Lygus* spp.			per ha (per acre)	PHI*	
Lygus spp. can sting the developing pods, resulting in damaged seeds. Monitor beans during the early pod-filling stages. A treatment may be required when there are 1–2 bugs per sweep later in the season.	dimethoate	Cygon 4 E	0.7–1 L (280–400 mL)	7	Some residual activity is expected from this product. Ground or aerial application. Do not feed treated threshings or crop refuse to livestock. Maximum 3 applications/yr.
		Lagon 480 E	0.7–1 L (280–400 mL)		
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	21	This product has no systemic activity. Ground and aerial application. For best results, apply during the early morning, before temperatures rise, and during the evening. Use 100–200 L of water/ha for ground application. Use 20 L of water/ha for aerial applications. Do not graze or feed on treated forage. Maximum 3 applications/yr. 24-hr re-entry period.
		Silencer 120 EC	83 mL (34 mL)	14	This product has no systemic activity. **Ground application only.** For best results, apply during the early morning, before temperatures rise, and during the evening. Do not graze or harvest treated forage, straw or hay for livestock feed. Maximum 3 applications/yr. 24-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

DRY EDIBLE BEAN INSECTS

Table 5–1. Chemical Control Options for Insects in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate		Comments (label precautions, re-entry periods, etc.)
GREEN CLOVERWORM (*Hypena scabra*)			per ha (per acre)	PHI*	
Several natural enemies help keep green cloverworm populations below action thresholds. Insecticides are only recommended if populations are extremely high, as they will also kill the natural enemy population.	endosulfan	Thiodan 4 EC	1.5–2.5 L (0.6–1.0 L)	2	Do not feed treated threshings or crop refuse to livestock. Do not use on lima beans.

* PHI = Pre-Harvest Interval (days)

DRY EDIBLE BEAN DISEASES

Table 5–2. Dry Edible Bean Seed and Soil-Applied Fungicide Recommendations

Active Ingredients	Product	Formulation	Dry Edible Bean Diseases			
			Anthracnose	Pythium Damping-Off	Fusarium Seedling Blight	Rhizoctonia
Insect and Disease Control						
Untreated Seed						
azoxystrobin	Dynasty 100FS[1]	F	+	—	—	+
diazinon + captan	Agrox B-2	P (DB)	—	—	+	—
diazinon + captan + thiophanate-methyl	DCT[1]	P	+	—	+	+
thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	F	—	+	+	+
Seed Pretreated With Fungicide						
diazinon + captan	Agrox CD		**For insect control only.** Disease control via fungicide pretreatment.			
Disease Control						
carbathiin + thiram	Vitaflo 280	LS	—	—	+	+
fludioxonil + metalaxyl-M	Apron Maxx RTA	F	—	+	+	+
	Apron Maxx RFC	F	—	+	+	+
metalaxyl	Apron FL	F	—	+	—	—
metalaxyl-M	Apron XL	LS	—	+	—	—
trifloxystrobin	Trilex FS	F	—	—	+	+

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable P = Powder LS = Liquid Suspension

+ = Recommended for disease listed — = Not Recommended

[1] Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS.

DRY EDIBLE BEAN DISEASES

Table 5–3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
SEED and SEEDLING DISEASES				
Seedling Diseases			per 100 kg seed	
Seedling diseases are present in all fields and all soil types. Maintain or build up good soil tilth by following a good crop rotation (3 yr between bean crops of any kind). Do not overwork the soil and avoid working it when it is wet. Apply seed treatments that will help protect the plant from root rots during germination and early growth. Use tolerant varieties. Consult your seed company and the Ontario Pulse Crops Committee Variety Trials at www.ontario.ca/crops.	diazinon + captan + thiophanate-methyl	DCT	1 L of slurry	**Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS.** Seedling blights and damping-off are also controlled. Use full rate and ensure good coverage by applying as a slurry. Available as a 400-g container that will treat 77 kg of dry bean seed. To make a slurry, use 520 g seed treatment/L of water. For control of pythium and phytophthora root rots, add metalaxyl.
PYTHIUM DAMPING-OFF (*Pythium* spp.)			per 100 kg seed	
This disease can occur on all soil types but losses are greatest on wet, clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Treat seed with metalaxyl or metalaxyl-M and plant into warm soils (16°C). Rotate 3–4 yr between bean crops. **Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS.** See *ANTHRACNOSE (Colletotrichum lindemuthianum)*, on page 89, for more details.	metalaxyl-M	Apron XL LS	20–40 mL	**For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL	46–110 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL		
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg seed.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	**For use in commercial seed treatment facilities only.** Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg of seed.

* PHI = Pre-Harvest Interval (days) "—" indicates no information was provided on the product label.

DRY EDIBLE BEAN DISEASES

Table 5–3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
FUSARIUM SEED and ROOT ROT (*Fusarium solani f. sp. phaseoli*)				
Seed Treatment			**per 100 kg seed**	
Fusarium begins as small, reddish-brown lesions on the taproot that join to form larger lesions, or streaks, as the plant ages. The lesion can extend up to the soil line. The splitting of the tap root, crown and lower stem often reveals a brown-reddish internal discolouration of the water-conducting tissue. Longitudinal cracks and adventitious roots may develop on damaged plants. These adventitious roots are formed above the damaged area. Late infection seldom results in dead plants but rather in stunted, unthrifty-looking ones. Disease development is promoted by soil compaction, short crop rotations and moisture stress. **Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS.** See *ANTHRACNOSE (Colletotrichum lindemuthianum)*, opposite page, for more details. Other seed treatment products may be needed to protect against other edible bean diseases.	diazinon + captan + thiophanate-methyl	DCT	1 L of slurry	**Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS.** Seedling blights and damping-off are also controlled. Use full rate and ensure good coverage by applying as a slurry. Available in a 400-g container that will treat 77 kg of dry bean seed. To make a slurry, use 520 g seed treatment/L of water. For control of pythium and phytophthora root rots, add metalaxyl.
	carbathiin + thiram	Vitaflo 280	260 mL	Ensure good seed coverage.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg seed.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	**For use in commercial seed treatment facilities only.** Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg of seed.
	diazinon + captan	Agrox B-2	320 mL	Available in a 2-kg container that will treat 625 kg of bean seed. Use full rate and ensure good coverage of seed. Seed within 1 month of treatment. Do not use on seed already treated with an insecticide.
	trifloxystrobin	Trilex FS	21 mL	**For use in commercial seed treatment facilities only.** Apply using standard commercial seed treatment equipment. Not for use in hopper-box, planter-box, slurry-box or similar seed treatment applications. Uniform application on seed is necessary to ensure seed safety and best disease protection.

* PHI = Pre-Harvest Interval (days) "—" indicates no information was provided on the product label.

DRY EDIBLE BEAN DISEASES

Table 5–3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
ANTHRACNOSE (*Colletotrichum lindemuthianum*)				
Seed Treatment			**per 100 kg seed**	
Anthracnose is best controlled by planting disease-free seed and using a seed treatment containing DCT or Dynasty 100FS. Should disease still appear, use a foliar fungicide as a rescue treatment.	diazinon + captan + thiophanate-methyl	DCT	1 L of slurry	**Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS.** Available in a 400-g container that will treat 77 kg of dry bean seed. To make slurry, use 520 g seed treatment/L of water. Use full rate and ensure good coverage by applying as a slurry. For control of pythium and phytophthora root rots, add metalaxyl.
	azoxystrobin	Dynasty 100FS	10 mL	**Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS.** For additional disease control, use in combination with Apron Maxx RFC or Cruiser Maxx Beans.
Foliar Treatment			**per ha (per acre)**	**PHI***
Rainy weather favours this disease, as spores are splashed from diseased areas and carried in wind-borne water droplets or by surface water throughout the field. Take note of weather forecasts, as wet conditions over a prolonged period of time can result in epidemics. Timing of foliar fungicides is important. Apply treatment when disease first appears.	azoxystrobin	Quadris	500 mL (200 mL)	15 Ground and aerial application. Apply 1st application at early flower or when disease first appears. If necessary, re-apply 10–14 days later if disease persists. Maximum 2 applications/yr.
	pyraclostrobin	Headline EC	400 mL (160 mL)	30 Ground and aerial application. Apply when disease first appears. If necessary, re-apply 10–14 days later if disease persists. Tank-mixing with Lance is not recommended, as precipitates can develop. To minimize risk of precipitates forming, use water >10°C and spray solution promptly. Maximum 2 applications/season.

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DRY EDIBLE BEAN DISEASES

Table 5–3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
RHIZOCTONIA (*Rhizoctonia solani*)			**per 100 kg seed**	
This disease occurs when conditions are cool and wet during planting or when these conditions result in a delay in seedling emergence or development. Mid-to-late-season moisture stress (dry conditions) can increase the disease incidence. Management practices include: (1) selecting varieties with good general tolerance to root rots, (2) promoting root growth through a good fertility program, (3) rotating crop (3 yr between bean crops), (4) not overworking the soil and avoiding working it when it is wet, (5) removing excessive water through increased tile drainage and minimizing compaction and (6) applying seed treatments that protect the plant during germination and early growth. Consult your seed company and the Ontario Pulse Crops Committee Variety Trials at www.ontario.ca/crops. **Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS.** See *ANTHRACNOSE (Colletotrichum lindemuthianum)*, previous page, for more details. Other seed treatment products may be needed to protect against other edible bean diseases.	azoxystrobin	Dynasty 100FS	10 mL	One application as a seed treatment. For additional disease control, use in combination with Apron Maxx RFC or Cruiser Maxx Beans.
	carbathiin + thiram	Vitaflo 280	260 mL	Ensure good seed coverage.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 Dynasty 100FS per 100 kg seed.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	**For use in commercial seed treatment facilities only.** Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg of seed.
	trifloxystrobin	Trilex FS	21 mL	**For use in commercial seed treatment facilities only.** Apply using standard commercial seed treatment equipment. Not for use in hopper-box, planter-box, slurry-box or similar seed treatment applications. Uniform application on seed is necessary to ensure seed safety and best disease protection.

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DRY EDIBLE BEAN DISEASES

Table 5–3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	PHI*	Comments (label precautions, re-entry periods, etc.)
FOLIAR, STEM and POD DISEASES					
ASIAN SOYBEAN RUST (*Phakopsora pachyrhizi*)			**per ha (per acre)**		
Edible beans are a host for Asian soybean rust. The extent to which these crops are impacted has yet to be determined. See *ASIAN SOYBEAN RUST (Phakopsora pachyrhizi)*, on page 32, for more details on this disease. See the OMAFRA website at www.ontario.ca/crops for updates and further details on management options, as well as the Grain Farmers of Ontario website at www.gfo.ca/.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	30	Ground and aerial application. Classified as a strobilurin fungicide; use in a preventive fungicide program (pre-infection). See label for resistance management strategy. Maximum 2 applications/yr.
	azoxystrobin	Quadris	500 mL (200 mL)	15	Ground and aerial application. Apply 1st application at early flower or when disease first appears. If necessary, re-apply 10–14 days later if disease persists. Maximum 2 applications/yr.
	propiconazole	Tilt 250 E	500–750 mL (200–300 mL)	30	Ground and aerial application. Make first application at the first sign of disease followed by a second application 14 days after the first application, if environmental conditions continue to be favourable for disease development. See label for resistance management strategy. Maximum 2 applications/yr.
	azoxystrobin + propiconazole	Quilt	1.0–1.5 L (400–600 mL)	30	Ground and aerial application. Make the first application at the first sign of disease. Apply the high rate only under conditions of high disease pressures. A second application at a 14-day interval may be needed if disease persists. Good spray coverage and canopy penetration are important for best results. Apply in a minimum of 45 L of water/ha for ground application. See label for resistance management strategy. Maximum 2 applications/yr.
BEAN RUST (*Uromyces appendiculatus*)			**per ha (per acre)**	**PHI***	
This disease is extremely rare in Ontario, arriving late in the season. Some dry bean market classes (e.g., pinto beans) can be very susceptible to rust. Consult your seed company and the Ontario Pulse Crops Committee Variety Trials at www.ontario.ca/crops. If rust arrives during flowering and early pod set, a treatment may be necessary.	propiconazole	Tilt 250 E	500 mL (200 mL)	30	Ground and aerial application. Apply when disease is first detected. Maximum 2 applications/yr.
		Bumper 418 EC	300 mL (121 mL)	30	Ground and aerial application. Apply when disease is first detected. Maximum 2 applications/yr.
	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	30	Ground and aerial application. Apply when disease first appears. If necessary, re-apply 10–14 days later if disease persists. Tank-mixing with Lance is not recommended as precipitates can develop. Maximum 2 applications/yr.

* PHI = Pre-Harvest Interval (days) "—" indicates no information was provided on the product label.

DRY EDIBLE BEAN DISEASES

Table 5–3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
WHITE MOULD (*Sclerotinia sclerotiorum*)			per ha (per acre)	PHI*	
Avoid soybeans, canola and other hosts in a 3-yr rotation, since these crops are susceptible to white mould. Rotate with non-host crops such as wheat, corn and barley. In fields with a history of the disease, select varieties with an upright structure. Lower plant populations and increased row width promote rapid drying of the plants and soil surface and therefore reduce potential for infection. Avoid excess fertilization. Those fields at risk have a past history of white mould and above-average foliage growth. All products must be used as a preventative measure as they will not be effective once the disease is present.	boscalid	Lance	560–770 g (227–312 g)	21	Ground and aerial application. Best used as a preventive measure. Apply at 20%–50% flowering. Apply a second time 7–10 days later, up to 50% flowering, if disease persists or weather conditions are favourable for disease development. Tank-mixing with Headline is not recommended, as precipitates can develop. Plant-back interval of 14 days for crops not on label. 4-hr re-entry period.
	fluazinam	Allegro	1.0 L (400 mL)	30	**Ground application only.** Best used as a preventive measure. Apply when plants are at early to mid-bloom (10%–50% bloom) and with repeat application, if necessary, 7–10 days later. Use sufficient water to ensure thorough coverage of foliage. Maximum 2 applications/yr. 24-hr re-entry period.
	iprodione	Rovral WDG	1.0–1.5 kg (0.4–0.6 kg)	—	Apply at 25%–75% bloom. Do not feed treated bean refuse to livestock. 12-hr re-entry period.
	thiophanate-methyl	Senator 70 WP	1.75–2.25 kg (700–900 g)	14	Apply when conditions favouring development of disease exist (warm, humid weather combined with heavy, dense crop foliage). Do not feed treated bean refuse to livestock.
	dicloran	Botran 75 WP	3.25 kg (1.3 kg)	2	Begin application when disease is anticipated, usually close to full bloom. Do not feed treated bean refuse to livestock.
	Coniothyrium minitans	Contans WG	0.5–4 kg (0.20–1.6 kg)	0	**Provides suppression only.** Good option for organically grown beans. **Ground application only.** This product should be applied at least 3 months prior to anticipated outbreak (i.e., prior to planting). Product should be incorporated as thoroughly as possible to a depth of 5–20 cm. Rate should be increased to 2–4 kg/ha (0.8–1.6 kg/acre) if incorporated to a depth greater than 5 cm. A post-harvest application may be applied in the fall to treat the soil prior to spring planting of a susceptible crop. Treated soils in the fall should not be disturbed to avoid bringing untreated sclerotia from lower soil layers to the top soil layer. Maximum 2 applications/yr.
	Bacillus subtilis	Serenade ASO	4.0–15.0 L (1.6–6.0 L)	0	**Provides suppression only.** Good option for organically grown beans. Ground and aerial application. Under conditions of moderate to high disease pressure, use the higher rate and shorter application intervals. For maximum effectiveness, apply prior to, or at the early stages of disease development. Apply in sufficient water volume to ensure full coverage for effective control. Repeat as necessary on a 7–10-day interval.

* PHI = Pre-Harvest Interval (days) "—" indicates no information was provided on the product label.

6. Canola and Mustard

CANOLA AND MUSTARD INSECTS

Table 6–1. Chemical Control Options for Insects in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
FLEA BEETLES (*Phyllotreta cruciferae* and *Phyllotreta striolata*)				
Seed Treatment			**per 100 kg seed**	
Hot, dry weather favours this pest. Once the crop reaches the 3–4-leaf stage, the plants are generally established and can compensate for the feeding damage.	imidacloprid	Gaucho 480 FL	820–1,640 mL	**For use in commercial seed treatment facilities only.** Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Do not graze livestock on treated areas for 4 weeks after planting. Do not use mustard greens that have had Gaucho 480 FL seed treatment for human consumption. Use higher rate if flea beetle populations are high.
Canola seedlings can withstand up to 25% defoliation in the cotyledon stage under good growing conditions without a significant reduction in yield. No thresholds are available for late-season pod feeding by the second generation of adults. Only when adult populations are extreme, and dry conditions are hindering the crop from compensating for the pod damage, is a spray recommended.	thiamethoxam + difenoconazole + metalaxyl M + fludioxonil	Helix Xtra	1.5 L	**For use in commercial seed treatment facilities only.** Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Follow resistance management recommendations as stated on label.
	imidacloprid + carbaithiin + thiram	Gaucho CS FL	1.4 L	**For use in commercial seed treatment facilities only.** Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Do not graze livestock on treated areas for 4 weeks after planting. Do not use mustard greens that have had Gaucho CS FL seed treatment for human consumption. Follow resistance management recommendations as stated on label.
Honeybees and other pollinators regularly visit canola and mustard flowers. Keep insecticide application to a minimum while the crop is in bloom to avoid bee-kills. Advise local beekeepers before you apply a pesticide, so that they may take precautions to protect their bees. For more information on preventing bee poisonings, see *Bee Poisoning*, on page 108.	clothianidin + carbathiin + thiram + metalaxyl	Prosper FL	1.25 L	**For use in commercial seed treatment facilities only.** Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. 30-day plant-back on cereal grains, grasses, non-grass animal feeds, and soybean and dried beans is required. 1-yr plant-back interval is required for leafy, root and tuber vegetables. Can be tank-mixed with Poncho 600 FS for longer season control of flea beetles. Follow resistance management recommendations as stated on label.

* PHI = Pre-Harvest Interval (days)

CANOLA AND MUSTARD INSECTS

Table 6–1. Chemical Control Options for Insects in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
Postemergence			**per ha (per acre)**	**PHI***	
Honeybees and other pollinators regularly visit canola and mustard flowers. Keep insecticide application to a minimum while the crop is in bloom to avoid bee-kills. Advise local beekeepers before you apply a pesticide, so that they may take precautions to protect their bees. For more information on preventing bee poisonings, see *Bee Poisoning*, on page 108.	cypermethrin	Ripcord 400 EC	50 mL (20 mL)	30	**For use in canola only.** Ground application only. Apply when signs of insect damage appear. Repeat treatment if necessary. Use minimum 110 L/ha of water.
	deltamethrin	Decis 5 EC	100–150 mL (40–60 mL)	14	Ground and aerial application. Use a minimum of 100 L/ha of water for ground application. Use a minimum of 11–22 L/ha of water for aerial application. 12-hr re-entry period.
	cyhalothrin-lambda	Matador 120 EC	83 mL (33 mL)	7	Ground and aerial application. Maximum 3 applications/yr. Maximum 1 aerial application. 24-hr re-entry period.
		Silencer 120 EC			
	carbaryl	Sevin XLR Plus	500 mL (200 mL)	60	Ground and aerial application. Seedling stage only (up to 4 weeks after plant emergence).
	carbofuran	Furadan 480 F	150 mL (60 mL)	60 (canola) 21 (grazing on mustard)	Ground and aerial application. Apply 2 weeks after seeding or when insects are first noticed. Use a minimum of 100 L/ha of water. 48-hr re-entry period.
DIAMONDBACK MOTH (*Plutella xylostella*)			**per ha (per acre)**	**PHI***	
Damage by diamondback moth is most noticeable during dry years. Risk factors include weedy fields and no-till practices. Cool, cloudy weather reduces moth activity and if this persists, females will die before eggs are laid. Honeybees and other pollinators regularly visit canola and mustard flowers. Keep insecticide application to a minimum while the crop is in bloom to avoid bee-kills. Advise local beekeepers before you apply a pesticide, so that they may take precautions to protect their bees. For more information on preventing bee poisonings, see *Bee Poisoning*, on page 108.	cyhalothrin-lambda	Matador 120 EC	83 mL (33 mL)	7	Ground and aerial application. Maximum 3 applications/yr. Maximum 1 aerial application. 24-hr re-entry period.
		Silencer 120 EC			

* PHI = Pre-Harvest Interval (days)

CANOLA AND MUSTARD INSECTS

Table 6–1. Chemical Control Options for Insects in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
CABBAGE SEEDPOD WEEVIL (*Ceutorhynchus obstrictus*)			per ha (per acre)	PHI*	
This is a serious pest in winter canola, though it can also impact early-planted spring canola. Adult weevils lay eggs directly into the seedpod. Pod feeding by the larvae can cause up to 35% yield loss. Apply insecticide to adults prior to egg-laying, as foliar insecticide will not control larvae within the canola pod. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for further information on pest biology and management options. Honeybees and other pollinators regularly visit canola and mustard flowers. Keep insecticide application to a minimum while the crop is in bloom to avoid bee-kills. Advise local beekeepers before you apply a pesticide, so that they may take precautions to protect their bees. For more information on preventing bee poisonings, see *Bee Poisoning*, on page 108.	cyhalothrin-lambda	Matador 120 EC Silencer 120 EC	83 mL (33 mL)	7	**For adult control only.** Ground and aerial application. Apply at bud-to-early-flowering stage. Maximum 1 application/yr. 24-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

CANOLA AND MUSTARD INSECTS

Table 6–1. Chemical Control Options for Insects in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
SWEDE MIDGE (*Contarinia nasturtii*)				
Swede midge is a serious pest of spring canola though winter canola can experience damage. Under heavy midge infestations, later-planted spring canola plants may experience stunting and malformed growth, with extremely reduced flower and pod formation. Thresholds and spray timing are not available at this time. For more information on this pest, see OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for further information on pest biology and management options.				No registered products at time of this publication.

* PHI = Pre-Harvest Interval (days)

CANOLA AND MUSTARD INSECTS

Table 6–1. Chemical Control Options for Insects in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)	
TARNISHED PLANT BUG (*Lygus lineolaris*)			per ha (per acre)	PHI*	
Tarnished plant bugs sting plant tissue, including pods and flowers. This causes scarring, malformation and dimpling or pitting on pods. They can also drill into the seed. If flowers are still present, they can prick the flower and cause it to abort. Spraying is recommended when 2 bugs per sweep are found after petal fall. Honeybees and other pollinators regularly visit canola and mustard flowers. Keep insecticide application to a minimum while the crop is in bloom to avoid bee-kills. Advise local beekeepers before you apply a pesticide, so that they may take precautions to protect their bees. For more information on preventing bee poisonings, see *Bee Poisoning*, on page 108.	cyhalothrin-lambda	Matador 120 EC Silencer 120 EC	83 mL (33 mL)	7	Ground and aerial application. Maximum 3 applications/yr. Maximum 1 aerial application. 24-hr re-entry period.

* PHI = Pre-Harvest Interval (days)

CANOLA AND MUSTARD DISEASES

Table 6–2. Chemical Control Options for Diseases in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
SEEDLING DISEASES				
SEED ROT and SEEDLING BLIGHT (*Alternaria* and *Rhizoctonia*)			**per 100 kg seed**	
Plant good quality seed under conditions that promote rapid germination (warm temperatures). Using a fungicide seed treatment will increase stand establishment. Maintain a good fertility balance and avoid excess fertilizer, which promotes disease and phytotoxicity. Avoid deep planting of seed.	thiamethoxam + difenoconazole + metalaxyl-M + fludioxonil	Helix Xtra	1.5 L	**For use in commercial seed treatment facilities only.** Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Follow resistance management recommendations as stated on label.
	carbathiin + thiram	Vitavax RS Fungicide	833 mL	Do not graze or feed livestock on seed area for 4 weeks after planting.
	imidacloprid + carbathiin + thiram	Gaucho CS FL	1.4 L	**For use in commercial seed treatment facilities only.** Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Do not graze livestock on treated areas for 4 weeks after planting. Do not use mustard greens that have had Gaucho CS FL seed treatment for human consumption. Follow resistance management recommendations as stated on label.
PYTHIUM DAMPING-OFF (*Pythium* spp.)			**per 100 kg seed**	
Plant good quality seed under conditions that promote rapid germination (warm temperatures). Using metalaxyl or metalaxyl-M seed treatment will increase stand establishment. Maintain a good fertility balance and avoid excess fertilizer, which promotes disease and phytotoxicity. Avoid deep planting of seed.	metalaxyl-M	Apron XL LS	20–40 mL	**For use in canola only. For use in commercial seed treatment facilities only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Apron FL	32–110 mL	**For use in canola only.** Do not graze or feed livestock on seeded area for 4 weeks after planting.
	thiamethoxam + difenoconazole + metalaxyl M + fludioxonil	Helix Xtra	1.5 L	**For use in commercial seed treatment facilities only.** Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Follow resistance management recommendations as stated on label.

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CANOLA AND MUSTARD DISEASES

Table 6–2. Chemical Control Options for Diseases in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate		Comments (label precautions, re-entry periods, etc.)
BLACKLEG (*Leptosphaeria maculans*)					
Seed Treatment			**per 100 kg seed**		
There are differences in susceptibility to blackleg between cultivars. Consult with your seed company and the Ontario Oil and Protein Seed Crop Committee Canola Variety Trial Results at www.ontariocanolagrowers.ca.	thiamethoxam + difenoconazole + metalaxyl M + fludioxonil	Helix Xtra	1.5 L		**For use in commercial seed treatment facilities only.** Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Follow resistance management recommendations as stated on label.
	carbathiin + thiram	Vitavax RS Fungicide	833 mL		Do not graze or feed livestock on seed area for 4 weeks after planting.
Maintain at least 3 yr between canola crops. Fungicide seed treatments will reduce seed-borne infection.	imidacloprid + carbathiin + thiram	Gaucho CS FL	1.4 L		**For use in commercial seed treatment facilities only.** Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Do not graze livestock on treated areas for 4 weeks after planting. Do not use mustard greens that have had Gaucho CS FL seed treatment for human consumption. Follow resistance management recommendations as stated on label.
Foliar Treatment			**per ha (per acre)**	**PHI***	
A foliar fungicide may be warranted if blackleg symptoms occur at the seedling and rosette stages or if a susceptible variety is being grown. Consult with your seed company and the Ontario Oil and Protein Seed Crop Committee Canola Variety Trial Results at www.ontariocanolagrowers.ca.	propiconazole	Tilt 250 E	500 mL (200 mL)	60	**For use in canola only.** Ground and aerial application. Apply at rosette stage, between 2nd true leaf and bolting.
		Bumper 418 EC	300 mL (121 mL)	60	**For use in canola only.** Ground and aerial application. Apply at rosette stage, between 2nd true leaf and bolting.
	azoxystrobin	Quadris	500 mL (200 mL)	30	**For use in canola only.** Apply at 2–6-leaf stage. See label for information regarding resistant strains of fungus. Plant-back interval of 30 days for broadleaf and root crops and 45 days for cereals required.

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CANOLA AND MUSTARD DISEASES

Table 6–2. Chemical Control Options for Diseases in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate		Comments (label precautions, re-entry periods, etc.)
SCLEROTINIA STEM ROT (WHITE MOULD) (*Sclerotinia sclerotiorum*)			**per ha (per acre)**	**PHI***	
This disease is often a problem when canola follows canola, white beans, soybeans or sunflowers. Use clean seed and a 4–5-yr rotation with non-host crops such as corn, wheat, barley or oats. At present, no resistant varieties exist. Keep fields clean of broad-leaved weeds, since many are alternate hosts. The disease is very destructive during periods of prolonged, wet weather. Losses of up to 50% can occur under conditions ideal for the disease.	prothioconazole	Proline	315–368 mL (128–149 mL)	36	Ground and aerial application. Apply when the crop is in the 20%–50% bloom stage. Best protection will be achieved when applied prior to petals beginning to fall. Higher rate is recommended for fields with a history of heavy disease pressure or for dense plant stands. Good spray coverage is essential. The lowest label rate of a non-ionic surfactant, AgSurf or Agral 90 may be tank-mixed. Maximum 1 application/yr. 24-hr re-entry period.
	cyprodinil + fludioxonil	Astound	775–975 g (314–395 g)	35	Ground and aerial application. Apply one application at 20%–30% bloom stage. Use a minimum of 200 L/ha of water for ground application. Use a minimum of 45 L/ha of water for aerial application. Apply the higher rate under conditions of high disease pressures. Maximum 1 application/yr. 12-hr re-entry period.
	iprodione	Rovral WP	1.0–1.5 kg (0.4–0.6 kg)	—	**For use in canola only.** Ground and aerial application. Use a minimum of 45 L/ha of water for aerial application. Apply at 20%–30% bloom. 12-hr re-entry period.
	azoxystrobin	Quadris	700–1,000 mL (283–405 mL)	30	**For use in canola only.** Apply at early bloom (prior to 30% bloom). Use the higher rate if there is a history of infection in the area and when environmental conditions favour disease development. See label for information regarding resistant strains of fungus. Plant-back interval of 30 days for broadleaf and root crops and 45 days for cereals required.
	boscalid	Lance	350 g (142 g)	21	Ground and aerial application. Apply at 20%–50% flowering. Apply a second time 7–10 days later up to 50% flowering if disease persists or weather conditions are favourable for disease development. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy. 4-hr re-entry period.
	Coniothyrium minitans	Contans WG	0.5–4 kg (0.20–1.6 kg)	0	**Provides suppression only. Ground application only.** This product should be applied at least 3 months prior to anticipated outbreak (i.e., prior to planting). Product should be incorporated as thoroughly as possible to a depth of 5–20 cm. Rate should be increased to 2–4 kg/ha (0.8–1.6 kg/acre) if incorporated to a depth greater than 5 cm. A post-harvest application may be applied in the fall to treat the soil prior to spring planting of a susceptible crop. Treated soils in the fall should not be disturbed to avoid bringing untreated sclerotia from lower soil layers to the top soil layer. Maximum 2 applications/yr.
	Bacillus subtilis	Serenade ASO	1.0–4.0 L (0.4–1.6 L)	0	**Provides suppression only.** Ground and aerial application. Under conditions of moderate to high disease pressure, use the higher rate and shorter application intervals. For maximum effectiveness, apply prior to, or at the early stages of, disease development. Apply in sufficient water volume to ensure full coverage for effective control. Repeat as necessary on a 7–10-day interval.

* PHI = Pre-Harvest Interval (days) "—" indicates no information was provided on the product label.

7. Stored Grain

STORED-GRAIN INSECTS

Table 7–1. Chemical Control Options for Insects in Corn, Wheat and Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
RUSTY GRAIN BEETLE (*Cryptolestes ferrugineus*)				
Protectant				
This beetle feeds on cracked or sound grain. Damage can be throughout the pile of grain. High infestations generate heat, causing grain to mould. The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on stored-grain insect management.	diatomaceous earth	Protect-It	Empty bin: 500 g per 100 m^2 Stored grain: 500–1,000 g/ metric tonne of grain	This product can be applied to dry containers where grain is transported or stored. The structure must remain empty for 1–2 weeks. For maximum effectiveness, the relative humidity must remain below 55% and the temperature above 15°C. See label for spot and crack treatment rates. For wheat grain treatment, 100 g/tonne of wheat can be used to control rusty grain beetle. Dust may be applied to grain as it enters the auger or conveyor feeder system during grain transfer into the storage facility.
Fumigant			**Grain bin, per 100 m^3**	
	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	**These products must be applied by a professional licensed applicator.** Do not fumigate below 5°C. Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is tightly sealed. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	
INDIAN MEAL MOTH (*Plodia interpuctella*)				
Protectant				
This moth is resistant to malathion. Larvae spin webbing. High populations result in a mat of grain with silks up to 50 cm deep. Remove webbed layer of grain before fumigation. The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on stored-grain insect management.	diatomaceous earth	Protect-It	Empty bin: 500 g per 100 m^2 Stored grain: 500–1,000 g/ metric tonne of grain	Apply at monthly intervals with the first appearance of moths and continue until early fall. In severe infestations, break up webbing with a rake before dusting and make second application 2 weeks later. Can be applied to dry containers where grain is transported or stored. The structure must remain empty for 1–2 weeks. For maximum effectiveness, the relative humidity must remain below 55% and the temperature above 15°C. See label for spot and crack treatment rates. Dust may be applied to grain as it enters the auger or conveyor feeder system during grain transfer into storage facility.

STORED-GRAIN INSECTS

Table 7–1. Chemical Control Options for Insects in Corn, Wheat and Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
Fumigant			**Grain bin, per 100 m³**	
	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	**These products must be applied by a professional licensed applicator.** Do not fumigate below 5°C. Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is tightly sealed. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	
GRANARY WEEVIL (*Sitophilus granarius*)				
Protectant				
Both adults and larvae feed on sound grain. Larvae spend their entire life in one kernel, feeding on the endosperm. The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on stored-grain insect management.	diatomaceous earth	Protect-It	Empty bin: 500 g per 100 m² Stored grain: 500–1,000 g/ metric tonne of grain	This product can be applied to dry containers where grain is transported or stored. The structure must remain empty for 1–2 weeks. For maximum effectiveness, the relative humidity must remain below 55% and the temperature above 15°C. See label for spot and crack treatment rates. Dust may be applied to grain as it enters the auger or conveyor feeder system during grain transfer into the storage facility.
Fumigant			**Grain bin, per 100 m³**	
	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	**These products must be applied by a professional licensed applicator.** Do not fumigate below 5°C. Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is tightly sealed. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	
LESSER GRAIN BORER (*Rhyzopertha dominica*)				
Fumigant			**Grain bin, per 100 m³**	
The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on stored-grain insect management.	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	These products must be applied by a professional licensed applicator. Do not fumigate below 5°C. Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is tightly sealed. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	

STORED-GRAIN INSECTS

Table 7–1. Chemical Control Options for Insects in Corn, Wheat and Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (label precautions, re-entry periods, etc.)
PEA WEEVILS/BEAN WEEVILS (*Bruchus pisorum/Acanthoscelides obtectus*)				
Fumigant			**Grain bin, per 100 m³**	
Adults lay their eggs in maturing beans in the field with no apparent visible damage. Heavily infested peas or beans can be fed to livestock. The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on stored-grain insect management.	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	These products must be applied by a professional licensed applicator. Do not fumigate below 5°C. Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is tightly sealed. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	
EUROPEAN GRAIN MOTH (*Nemapogon granella*)				
Fumigant			**Grain bin, per 100 m³**	
Similar to Indian meal moth, the larvae of this pest spin webbing on the grain, which can typically be found within the top 50 cm. The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on stored-grain insect management.	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	These products must be applied by a professional licensed applicator. Do not fumigate below 5°C. Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is tightly sealed. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	

8. Using Pesticides in Ontario

Read the latest product label before using a pesticide!
Review the Grower Pesticide Safety Course Manual.
Keep detailed spray records.

Federal Registration of Pesticides

Before a pesticide can be sold or used in Ontario, it must be registered under the federal *Pest Control Products Act* (PCP Act) and be classified under the provincial *Pesticides Act*. The Pest Management Regulatory Agency (PMRA) of Health Canada registers pesticides for use in Canada following an evaluation of scientific data to ensure that the product has merit and value. It also ensures that the human health and environmental risks associated with its proposed use are acceptable.

The PMRA re-evaluates registered pesticides to determine whether today's health and environmental protection standards are still met when following the label directions. Outcomes of a re-evaluation can be:

- no change in the registration
- label amendments (i.e., changes to personal protective equipment requirements, re-entry intervals and buffer zones)
- modifications to existing maximum residue limits (MRLs)
- elimination or phasing-out of certain uses or formulations
- no further acceptance of the registration

The pesticide label is a legal document. It prescribes how the pesticide can be legally used. Off-label use is prohibited. It is against the law to use the pesticide in any other way or on any other crop or pest than as specified on the label. Labels for all registered pesticides are under Search Pesticide Labels on the PMRA website at www.pmra-arla.gc.ca. Ensure you have the most current label and are aware of any re-evaluation decisions.

Regulation of Pesticides in Ontario

The Ministry of the Environment (MOE) is responsible for regulating the sale, use, transportation, storage and disposal of pesticides in Ontario. Ontario regulates pesticides by placing appropriate education, licensing and/or permit requirements on their use, under the *Pesticides Act* and Regulation 63/09. All pesticides must be used in accordance with requirements under the *Pesticides Act* and Regulation 63/09, which are available on the e-laws website at www.e-laws.gov.on.ca or by calling Service Ontario at 1-800-668-9938 or 416-326-5300.

Classification of Pesticides

Before a federally registered pesticide can be sold or used in Ontario, it must be classified under the provincial *Pesticides Act*. The Ontario pesticide classification system consists of 11 classes. The Ontario Pesticides Advisory Committee (OPAC) is responsible for reviewing and recommending to the MOE the classification of pesticide products. Pesticide products are classified on the basis of their toxicity, environmental or health hazard, persistence of the active ingredient or its metabolites, concentration, usage, federal class and registration status. This classification system provides the basis for regulating the distribution, availability and use of pesticide products in Ontario. Once approved by the MOE, classified products are posted on the MOE website at www.ontario.ca/environment.

Certification and Licensing

Growers and Their Assistants

Growers must be certified through the Grower Pesticide Safety Course in order to buy and use Class 2 and 3 pesticides on their farms. They do not require this certification to use Class 4, 5, 6 or 7 pesticides. For information about certification for growers and training for assistants to growers, visit the Ontario Pesticide Education Program website at www.opep.ca or call 1-800-652-8573.

Commercial Applicators (Exterminators) and Their Assisting Technicians

For more information about exterminator licensing and technician training, visit the Ontario Pesticide Training and Certification website at www.ontariopesticide.com/index.cfm/home-page or call 1-888-620-9999 or 519-674-1575.

For more information about pesticide regulations, certification and licensing, see:

- Inside front cover of this publication
- Pest Management Regulatory Agency (PMRA) website: www.pmra-arla.gc.ca
- PMRA Pest Management Information Service: 1-800-267-6315 (from within Canada) or 1-613-736-3799 (from outside Canada)
- Ontario Ministry of the Environment (MOE) website: www.ontario.ca/environment
- Regional MOE Pesticides Specialist (See Appendix C. *Ontario Ministry of the Environment Regional Contact Information*, on page 126.)
- Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) website: www.ontario.ca/omafra
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) website: www.opep.ca
- Ontario Pesticide Training & Certification website: www.ontariopesticide.com/index.cfm/home-page

Pesticide Application Information

When you decide to use a pesticide, choose the most appropriate formulation and application method for your situation. Use only a properly calibrated sprayer. Choose less toxic alternatives when possible. Take all possible precautions to prevent the exposure of people and non-target organisms to the pesticide. Read the most current pesticide label thoroughly before application. The label provides important information, such as:

- directions for use (rates of application, crops it can be used on, target pests, crop rotation restrictions, total number of applications, droplet size/nozzle type, application equipment, timing and ideal weather conditions)
- required personal protective equipment
- hazard symbols and warnings
- re-entry intervals
- buffer zones
- precautionary statements
- steps to be taken in case of an accident
- disposal

For more information on hazards, consult the Material Safety Data Sheet (MSDS) or contact the manufacturer.

For more information on pesticide application, see:

- OMAFRA Factsheet *Calibrating Airblast Sprayers*, Order No. 10-047
- OMAFRA Factsheet *Adjusting, Maintaining and Cleaning Airblast Sprayers*, Order No. 10-069
- OMAFRA Factsheet *How Weather Conditions Affect Spray Applications*, Order No. 09-037w (website only)
- OMAFRA Factsheet *Pesticide Drift from Ground Applications*, Order No. 11-001
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) videos at www.opep.ca/Video/default.htm
- OMAFRA/Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- OMAFRA Factsheet *Pesticide Contamination of Farm Water Supplies – Recommendations on Avoidance, Cleanup and Responsibilities*, Order No. 10-097

Re-Entry Intervals

The re-entry interval, also referred to as Restricted Entry Interval (REI), is the period of time following a pesticide application during which workers must not enter the treatment area without wearing protective clothing and personal protective equipment. This allows any pesticide residue and vapours to dissipate from the treatment location (e.g., field), preventing the possibility of inadvertent pesticide exposure.

The PMRA reviews each pesticide to determine whether the label should include a specific re-entry interval. If the re-entry interval is not stated on the label, assume that the spray solution must be dry before re-entry can occur. Some pesticides have labels that carry a warning about working in treated crops. Follow the label recommendations.

Days to Harvest for Food Crops (Pre-Harvest Intervals, Pregrazing and Feeding Intervals)

These intervals state the minimum time that must pass between the last pesticide application and the harvesting of the crop, or the grazing or cutting of the crop for livestock feed. If you harvest a crop before the pre-harvest interval (PHI) has passed, there may be pesticide residues in excess of the maximum residue limits (MRLs) set by PMRA.

"Up to the day of harvest" means the same as 0 days PHI; however, the REI may be more restrictive (i.e., a 12-hr re-entry interval) and must be observed for harvesting that occurs on the day of application.

To avoid exceeding the maximum residue limits, always follow the directions on the label.

Buffer Zones

Buffer zones are areas left untreated to protect an adjacent sensitive area, such as sensitive terrestrial and aquatic habitats, well heads, non-target crops and areas where children play. Generally, a buffer zone is the downwind distance separating the point of direct pesticide application from the nearest boundary of a sensitive habitat.

Leave a suitable buffer zone between the treatment area and adjacent sensitive areas. Buffer zones may vary depending on the method of application (i.e., aerial, field boom, hand-held sprayer). Some pesticide labels specify buffer zone requirements. Check the pesticide label for any buffer zone requirements.

Sensitive terrestrial habitats include hedgerows, grasslands, shelterbelts, windbreaks, forested areas, woodlots and vegetative strips.

Sensitive freshwater habitats include lakes, rivers, streams, creeks, reservoirs, marshes, wetlands, ponds and commercial fish ponds.

Health Canada's Pest Management Regulatory Agency has an online spray drift calculator that allows applicators to modify the labelled buffer zones as required by the product label, based on weather conditions, the category of sprayer or droplet size. For more information, see the Buffer Zone Calculator at www.hc-sc.gc.ca/cps-spc/pest/agri-commerce/driftderive/calculator-calculatrice-eng.php.

Setback Distances for Water Bodies

It is an offence under the federal *Fisheries Act* to introduce into water any material that may be harmful to fish or fish habitat. To protect these waters, applicators must determine a suitable setback distance between the area to be protected and the area where pesticide treatments are planned (if one is not specified on the pesticide label). The protected area includes the water body as well as adjacent riparian (riverbank) areas that contribute to fish food and habitat.

Protect the Environment

Protect Water Sources

According to the British Crop Protection Council (BCPC), 40%–70% of surface water pesticide contamination comes from mixing and filling areas.

Where possible, load or mix pesticides on impermeable surfaces that are safely away from watercourses or environmentally sensitive areas. Collect drainage and run-off and dispose of it safely (*Your Guide to Using Pesticides*, BCPC 2007).

Clean your spray equipment away from wells, ponds, streams and ditches. Apply the diluted rinse water (usually at a ratio of 10:1) to the treatment area (crop) but do not exceed the pesticide rate recommended on the label.

Do not make a direct connection between any water supply (e.g., public supply, wells, watercourse or pond) and a spray tank. Use an anti-backflow device or intermediate system to prevent back-siphoning that could contaminate the water supply.

Immediately contain and clean up any spills to prevent contamination to water sources.

Check the pesticide label for specific instructions on water source protection.

For more information on protecting water sources, see:

- OMAFRA Factsheet *Pesticide Contamination of Farm Water Supplies — Recommendations on Avoidance, Cleanup and Responsibilities*, Order No. 10-097.
- OMAFRA Factsheet *Groundwater — An Important Rural Resource: Protecting the Quality of Groundwater Supplies*, Order No. 06-115
- OMAFRA/Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13

Bee Poisoning

Honey bees, native bee species and other beneficial insects are important pollinators for many Ontario crops. Insecticides, some of which kill bees, are required for insect control but with careful management, both pollination and insect control can be achieved. Growers and licensed commercial exterminators can protect bees by following these suggestions:

- Before applying a pesticide, advise local beekeepers so they can move colonies out of the danger area. Contact the Provincial Apiarist at 1-888-466-2372, ext. 63595, for a list of the beekeepers in the area or see www.ontario.ca/crops and click "Apiculture" for a list of provincial bee inspectors who know the local beekeepers.

- Do not apply insecticides while fruit trees are in bloom. The *Bees Act* makes it an offence to do so in Ontario. Do not spray any flowering crop on which bees are foraging and read the pesticide label for guidelines.

- Time insecticide applications to minimize bee poisoning. Daytime treatments, when bees are foraging, are most hazardous. Insecticide applications in the evening are the safest. Spraying after 7 PM allows the spray to dry before the bees are exposed to it the next day. This is the most successful way to avoid bee damage. Early morning is the next best time, but spraying should be completed before 7 AM. While honeybees and most other pollinating insects do not usually forage at temperatures below 13°C, bumblebees do. If you plan to spray in the morning, contact beekeepers who have bees within 1 km of your crop. The beekeepers will then have the option of taking protective action.

- Beekeepers can place wet bags in the entrance of the hive to disrupt the flight of the bees for up to 12 hr and provide more time for spray to dry. An opening of 2.5 cm on each side of the hive entrance is necessary so the bees can get out and ventilate the hive.

- Beekeepers should remove honeybee colonies as soon as pollination is complete and before any postbloom insecticides are applied.

- Honeybees may be poisoned by visiting weeds or cover crops, such as dandelions or clovers that are in bloom in the orchard or field. Where possible, mow down such crops prior to a spray to help safeguard the bees.

- Do not apply insecticide on windy days to prevent drift toward nearby hives.

- If there is a risk of honeybee poisoning, try to choose an insecticide that is not highly toxic to the bees from the list in Table 9–7, *Relative Toxicity of Insecticides to Honeybees*, on page 121. When there is a choice, choose a product formulation that is less hazardous to bees. EC formulations are less toxic than WP formulations.

Table 9–7, *Relative Toxicity of Insecticides to Honeybees*, on page 121, shows the relative toxicity of products to honeybees as determined by laboratory and field tests.

Manage Drift

Pesticide drift is the aerial movement and unintentional deposit of pesticide outside the target area. Drift results in wasted product and compromised crop protection, and can adversely affect nearby sensitive environmental areas, crops and wildlife. The following strategies can help reduce the risk of pesticide drift:

- Do not spray when wind speeds are high or gusty. These conditions increase the potential for spray drift. Check pesticide labels for allowable wind speeds for spraying applications. Some labels may not provide this specific information, in which case do not spray when wind is less than 2 km/h or over 16 km/h. Constantly monitor wind conditions during spraying, using a good quality wind meter. Record the wind speed and direction. As wind conditions change, you may need to make adjustments to further reduce the drift potential, such as adjusting water volume upwards, minimizing nozzle-to-target distance, changing nozzle

technology, changing fields because of surrounding influences or stopping spraying until conditions improve.

- Do not spray during periods of dead calm. Periods of dead calm may occur in early morning or late evening, at which time the temperature is usually cooler and the relative humidity is typically higher. The combination of these factors can result in drift-sized droplets staying in the field. When the wind picks up, these spray droplets can move away from the target area, possibly causing injury to adjacent non-target areas.
- Use the recommended sprayer output.
- Use a nozzle that will produce the appropriate droplet size if specified on the pesticide label. Nozzles that produce fine droplets are rarely, if ever, required.
- Use the most appropriate nozzle for the type of application. Where practical, use air induction/venturi nozzles, which significantly reduce drift when compared to conventional nozzles.
- Check the height of the boom to the target, or distance from airblast boom to the target, and minimize the distance as much as possible while still maintaining spray uniformity.
- Follow buffer zone requirements for the protection of adjacent sensitive areas as outlined on the pesticide label.
- Use spray plume protection where practical or available (hoods, shrouds, screens and air curtains).
- Use drift-reducing adjuvants in the spray tank as directed on the label. Sprayer agitators (e.g., paddle or hydraulic return) have been shown to reduce the effectiveness of certain drift-reducing adjuvants.
- Use wick weeders instead of spraying when possible.
- Use non-volatile pesticide formulations or products when possible.

For more information about spray drift, see:

- OMAFRA Factsheet *Pesticide Drift from Ground Applications*, Order No. 11-001
- OMAFRA/Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) videos *How to Manage Spray Drift* and *Spray Drift Reduction Through Air Induction*, available at www.opep.ca/Video/default.htm

Pesticide Disposal

Empty Pesticide Containers (up to 23 L)

Never re-use empty containers.

The Ontario Empty Pesticide Container Recycling Program is available free of charge to growers and commercial applicators. Through this program, you can return triple-rinsed or pressure-rinsed plastic pesticide containers (up to 23 L) to pesticide container collection depots located throughout the province. Remove the cap and booklet from the pesticide container before recycling. To locate the closest pesticide container collection depot, visit the CleanFARMS™ website at www.cleanfarms.ca, call your local dealer or call CleanFARMS™ at 416-622-4460.

Empty Pesticide Containers (greater than 23 L)

Growers and commercial applicators can return expired pesticide containers that are greater than 23 L in size. Contact your local dealer for details on disposal of these containers or call CleanFARMS™ at 416-622-4460.

Surplus Spray Mix

The best approach to disposing of surplus spray mix is to avoid creating it by planning the spray job accurately.

When this is unavoidable, dispose of excess spray mix by spraying it on other crops that require an application of this pesticide. Before spraying, check the label to make sure the pesticide is registered for use on that other crop.

If you cannot find another crop to spray, dilute the remaining spray mix by adding 10 parts of water for each 1 part of spray mix. The diluted solution can be safely applied to the original treated area as long as you do not exceed the pesticide rate recommended on the label. Be sure to check the label for any restrictions about crop rotation, days to harvest or surplus spray mix disposal.

Never re-spray the treated field with undiluted spray mix. Spraying an area twice will double the recommended pesticide rate. This may cause illegal pesticide residues in the harvested crop or harmful residues in the soil that can cause crop damage.

Surplus Pesticides in Storage

Be sure to safely dispose of pesticides that you do not need or cannot use. Options for proper disposal include:

- Contact the supplier. It is sometimes possible to return unused pesticide if it is still in its original, unopened container.
- Hire a waste hauler who is licensed under Part V of the *Environmental Protection Act* to carry hazardous wastes. Look in the Yellow Pages of your telephone directory under Liquid Waste Removal.
- Check your local paper or visit the CleanFARMS™ website (www.cleanfarms.ca) for upcoming Obsolete Pesticide Collection Days.
- Contact your municipality to see if any waste collection days are scheduled and verify whether quantities of agricultural pesticides will be accepted.

Storing Pesticides

Ontario's *Pesticides Act* and Regulation 63/09 provide details on storage requirements for pesticide storage facilities. The storage requirements that must be followed are dependent on which classes of pesticides you store.

	Pesticide Classes			
Storage requirements	**Class 2**	**Class 3**	**Class 4, 5 & 7**	**Class 6**
No contact with food or drink	✔	✔	✔	✔
Not an impairment to health and safety	✔	✔	✔	
Clean and orderly	✔	✔	✔	
Warning sign G posted*	✔	✔	✔	
Emergency telephone numbers posted**	✔	✔	✔	
Vented to outside	✔	✔		
Limited access (locked)	✔	✔		
No floor drain	✔	✔		
Respiratory protection and protective clothing kept readily available	✔	✔		
Area used primarily for pesticides	✔			

Note: Sufficient precautions are needed in your storage area to prevent the pesticide from entering the natural environment. Ensure your floor drain does not enter the natural environment.

* Refer to MOE's website www.ene.gov.on.ca/en/land/pesticides for requirements for warning sign G. These signs can be purchased from your pesticide dealer/vendor.

** Emergency contact numbers must include telephone numbers for the local fire department, hospital and poison control centre. The number for the MOE Spills Action Centre (1-800-268-6060) should also be readily available.

For more information about storing pesticides, see:

- OMAFRA Factsheet, *Farm Pesticide Storage Facility*, Order No. 11-005
- OMAFRA/Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) Grower Pesticide Safety Course Manual, available at www.opep.ca. Select Online Tutorial.

Pesticide Spills

If a pesticide spill causes, or is likely to cause, an adverse effect that is greater than that which would result from the proper use of the pesticide, you must notify the Ministry of the Environment Spills Action Centre at 1-800-268-6060 (24 hr a day, 7 days a week) and your municipality.

A spill is defined as a discharge of pollutant that is abnormal in quality or quantity, from or out of a structure, vehicle or other container into the environment. An incident such as an overturned pesticide sprayer that results in the loss of the spray solution to the environment is an example of a spill. A pesticide container that ruptures and leaks its contents is another example of a spill. The discharge or spraying of a pesticide in an unapproved area, commonly referred to as an overspray, is also considered a spill.

Before you begin to clean up a spill of any nature, remember to protect yourself against pesticide exposure. Wear the proper protective clothing and personal protective equipment. If the spill occurs inside an enclosed area (e.g., a pesticide storage area or a vehicle during transport), ventilate the area first. Once you have protected and/or removed yourself and other persons or animals from the spill site, take additional measures to stop the spill at the source and prevent it from spreading and/or contaminating watercourses. Specific precautions, emergency contact information and first aid procedures may be found on the label.

For minor spills, it may be possible to remediate the problem:

- **For a liquid spill** — Cover the spill with a thick layer of absorbent material such as kitty litter, vermiculite or dry soil. Sweep or shovel the material into a waste drum and dispose of the contents as you would a hazardous waste.
- **For a dust, granular or powder spill** — Sweep or shovel the material into a waste drum and dispose of the contents as you would a hazardous waste.

For major spills, it is essential to stop the spill from spreading. The clean-up guidelines above may not be appropriate for all spill situations. Once you have contained the spill, follow directions from the manufacturer and regulatory authorities on cleaning the contaminated area.

For information on preventing spills, see:

- OMAFRA Factsheet, *Ways to Avoid Pesticide Spills*, Order No. 96-025
- OMAFRA/Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) Grower Pesticide Safety Course Manual, available at www.opep.ca. Select Online Tutorial.

For pesticide poisonings and pesticide injuries, call:

Poison Information Centre:

1-800-268-9017

(TTY) 1-877-750-2233

For more information, see inside back cover on *Emergency and First Aid Procedures for Pesticide Poisoning*.

9. Pesticides Used on Field Crops in Ontario

Table 9–1. Seed Treatments Used on Field Crops

TRADE NAME	Active Ingredient	Chemical Family	Risk of Resistance Developing[1]	Formulation	Crops	Manufacturer
Fungicides						
Anchor	carbathiin + thiram	anilide + dithiocarbamates	low	F (DB)	soybeans	Chemtura Canada Co.
Allegiance FL	metalaxyl	acylamine	medium	F	canola, cereals, corn, forages, soybeans	Bayer CropScience
Apron FL	metalaxyl	acylamine	medium	F	canola, cereals, corn, forages, soybeans	Bayer CropScience
Apron XL LS	metalaxyl-M	acylamine	medium	LS	canola, corn, dry edible beans, forages, soybeans, wheat	Syngenta Crop Protection
Apron Maxx RTA	fludioxonil + metalaxyl-M	phenylpyrrole + acylamine	low to medium	F	dry edible beans, soybeans	Syngenta Crop Protection
Apron Maxx RFC	fludioxonil + metalaxyl-M	phenylpyrrole + acylamine	low to medium	F	dry edible beans, soybeans	Syngenta Crop Protection
Baytan 30	triadimenol	triazole	low to medium	F	barley, wheat	Bayer CropScience
Captan FL	captan	phthalimide	low	F	beans, corn, soybeans	Norac Concepts Inc.
Dividend XL RTA	difenoconazole + metalaxyl-M	triazole + acylamine	low to medium	F	wheat	Syngenta Crop Protection
Dynasty 100FS	azoxystrobin	strobilurin	low	F	corn, dry edible beans	Syngenta Crop Protection
Gemini	triticonazole + thiram	triazole + dithiocarbamate	low to medium	F	barley, oat, wheat	BASF Canada
Maxim 480 FS	fludioxonil	phenylpyrrole	low	F	corn, soybeans	Syngenta Crop Protection
Proseed	fludioxonil	phenylpyrrole	low	F	wheat	Syngenta Crop Protection
Rancona Apex	ipconazole	triazole	medium	F	barley, oat, rye, wheat,	Chemtura Canada Co
Raxil MD	tebuconazole + metalaxyl	triazole + acylamine	low to medium	F	barley, oat, wheat	Bayer CropScience
Raxil T	tebuconazole	triazole	low to medium	F	barley, oat, wheat	Bayer CropScience
Thiram 75 WP	thiram	dithiocarbamates and relatives	low	P	alfalfa	Chemtura Canada Co.
Trilex FL	trifloxystrobin	strobilurin	high	F	corn, dry edible beans, soybeans	Bayer CropScience

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable LS = Liquid Suspension P = Powder

[1] Risk of resistance based on continuous use of product.

Table 9–1. Seed Treatments Used on Field Crops

TRADE NAME	Active Ingredient	Chemical Family	Risk of Resistance Developing[1]	Formulation	Crops	Manufacturer
Vitaflo 280	carbathiin + thiram	anilide + dithiocarbamates	low	F	barley, corn, dry edible beans, flax, oat, rye, soybeans, wheat	Chemtura Canada Co.
Vitavax RS Fungicide	carbathiin + thiram	anilide + dithiocarbamates	low	F	canola, mustard, rapeseed	Bayer CropScience
Vortex FL	ipconazole	triazole	medium	F	corn	Bayer CropScience
Insecticides						
Cruiser 5FS	thiamethoxam	chloronicotine	medium to high	F	barley, corn, dry edible beans, soybeans, wheat	Syngenta Crop Protection
Cruiser 350FS	thiamethoxam	chloronicotine	medium to high	F	barley, dry edible beans, wheat	Syngenta Crop Protection
Gaucho 480FL	imidacloprid	chloronicotine	medium to high	F	canola, seed corn only, mustard	Bayer CropScience
Poncho 600FS	clothianidin	chloronicotine	medium to high	F	canola, corn	Bayer CropScience
Fungicides With Insecticides						
Agrox B-2	diazinon + captan	organophosphate + phthalimide	low	P (DB)	corn, dry edible beans, soybeans	Norac Concepts Inc.
Agrox CD	diazinon + captan	organophosphate + phthalimide	low	P (DB)	corn, dry edible beans, soybeans	Norac Concepts Inc.
Cruiser Maxx Beans	thiamethoxam + metalaxyl-M + fludioxonil	chloronicotine + acylamine + phenylpyrrole	low to medium	F	dry edible beans, soybeans	Syngenta Crop Protection
DCT	diazinon + captan + thiophanate-methyl	organophosphate + phthalimide + benzimidazole	low	P (DB)	dry edible beans	Norac Concepts Inc.
Gaucho CS	imidacloprid + carbathiin + thiram	chloronicotine + anilide + dithiocarbamates	low to medium	F	canola, mustard, rapeseed	Bayer CropScience
Helix Xtra	thiamethoxam + difenoconazole + metalaxyl-M + fludioxonil	chloronicotine + triazole + acylamine + phenylpyrrole	low to medium	F	canola, mustard	Syngenta Crop Protection
Prosper	clothianidin + carbathiin + thiram + metalaxyl	chloronicotine + anilide + dithiocarbamates + acylamine	low to medium	F	canola, rapeseed	Bayer CropScience

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable LS = Liquid Suspension P = Powder

[1] Risk of resistance based on continuous use of product.

Table 9–2. Foliar Fungicides Used on Field Crops

TRADE NAME	Active Ingredient	Fungicide Classification	Pre-Harvest Interval	Relative Toxicities	Aerial Application	Manufacturer	Use and Notes
Astound	cyprodinil + fludioxonil	aniline-pyrimidines + phenylpyrrole	35	low	yes	Syngenta Crop Protection Canada	canola
Botran 75 W	dichloran	nitroaniline	2	low	yes	Gowan Company	dry edible beans
Bumper 418 EC	propiconazole	triazole	canola: 60 cereals: 45 corn: 14 dry edible beans: 28	low	yes for all crops listed	MANA Canada	barley, canola, corn, dry edible beans, oat, soybeans (for seed only), wheat
Caramba	metconazole	triazole	30	low	yes for all crops listed	BASF Canada	barley, oat, rye, wheat
Contans	*Coniothyrium minitans*	biological fungicide	canola: 0 dry edible beans: 0 soybeans: 0	low	ground	Plant Products Co. Ltd	canola, dry edible beans, soybeans
Dithane DG Rainshield	mancozeb	dithiocarbamate	wheat: 40	low	yes for all crops listed	Dow AgroSciences	alfalfa (for seed only), spring and winter wheat
Folicur 250 EW	tebuconazole	triazole	barley: 36 oat: 36 soybeans: 20 wheat: 36	low	yes for all crops listed	Bayer CropScience	barley, oat, soybeans, wheat
Folicur 432 F	tebuconazole	triazole	barley: 36 oat: 36 soybeans: 20 wheat: 36	low	yes for all crops listed	Bayer CropScience	barley, oat, soybeans, wheat
Headline EC	pyraclostrobin	strobilurin	corn: 7 dry edible beans: 7 oat: See Note. soybeans: 21 wheat: See Note.	low	yes for all crops listed except corn	BASF Canada	barley, corn, dry edible beans, oat, rye, soybeans, wheat **Note:** Do not apply to cereals after the boot stage (Zadok's 47 and beyond).
Lance WDG	boscalid	carboxamide	21	low	yes for all crops listed	BASF Canada	canola, dry edible beans
Proline 480 SC	prothioconazole	triazole	barley: 30 canola: 36 corn: 14 oat: 30 soybeans: 20 wheat: 30	low	yes for all crops listed except for all cereals	Bayer CropScience	barley, canola, corn, oat, soybeans, wheat
Prosaro 250 EC	prothioconazole + tebuconazole	triazole	barley: 36 wheat: 36	low	yes	Bayer CropScience	barley, wheat

Table 9–2. Foliar Fungicides Used on Field Crops

TRADE NAME	Active Ingredient	Fungicide Classification	Pre-Harvest Interval	Relative Toxicities	Aerial Application	Manufacturer	Use and Notes
Quadris	azoxystrobin	strobilurin	canola: 30 dry edible beans: 15 seed corn: 7 soybeans: 15	low	yes for all crops	Syngenta Crop Protection Canada	canola, seed corn, dry edible beans, soybeans
Quilt	azoxystrobin + propiconazole	strobilurin + triazole	barley: See Note. corn: 14 corn for silage: 30 dry edible beans: 30 soybeans: 30 wheat: See Note.	low	yes for all crops listed	Syngenta Crop Protection Canada	barley, corn, dry edible beans, soybeans, wheat **Note:** Do not apply to cereals after the boot stage (Zadok's 47 and beyond).
Rovral WP	iprodione	dicarboximide	14	low	yes for all crops listed	Bayer CropScience	canola, dry edible beans
Senator 70 WP	thiophanate-methyl	benzimidazole	14	low	yes for all crops listed	Engage Agro	white beans
Serenade ASO	*Bacillus subtilis*	biological fungicide	canola: 0 dry edible beans: 0 soybeans: 0	low	ground	United Agri Products Canada	canola, dry edible beans, soybeans
Stratego 250 EC	trifloxystrobin + propiconazole	strobilurin + triazole	barley: See Note. oat: See Note. soybeans: 20 wheat: See Note.	low	yes for all crops listed except for soybeans	Bayer CropScience	barley, oat, soybeans, wheat **Note:** Do not apply to cereals after the boot stage (Zadok's 47 and beyond).
Tilt 250 E	propiconazole	triazole	canola: 60 cereals: 45 corn: 14 dry edible beans: 28 soybeans: 30	low	yes for all crops listed	Syngenta Crop Protection Canada	barley, canola, corn, dry edible beans, oat, soybeans, wheat

Table 9–3. Foliar Insecticides Used on Field Crops

TRADE NAME	Active ingredient	Insecticide Classification	Pre-Harvest Interval	Relative Toxicities	Aerial Application	Manufacturer	Use and Notes
Bioprotec CAF	*Bacillus thuringiensis*	bacterial toxin	corn: 1	low	ground	United Agri Products Canada Inc.	field corn
Concept	imidacloprid + deltamethrin	chloronicotine + pyrethroid	soybeans: 20	moderate	ground	Bayer CropScience	soybeans Toxic to bees.
Coragen	chlorantraniliprole	diamide	alfalfa: 0 field corn: 14 seed corn: 1 grass forages: 0	low	ground	DuPont Canada	alfalfa, field and seed corn, grass forages (seed production only)
Cygon 480 EC	dimethoate	organophosphorus	alfalfa: 2 canola: 21 dry edible beans: 7 forages: 2 soybeans: 30	moderate	yes for all crops listed	Cheminova Canada	alfalfa, canola, dry edible beans, forages, soybeans Toxic to bees.
Decis 5.0 EC	deltamethrin	pyrethroid	canola: 14 corn: 5	moderate	yes for all crops listed except corn	Bayer CropScience	barley, canola, corn, mustard, oat, wheat Toxic to bees.
Delegate WG	spinetoram	spinosyn	cereals: 21 soybeans: 28	low	no	Dow AgroSciences Canada	barley, oat, rye, soybeans, wheat
Dipel 2X DF	*Bacillus thuringiensis*	bacterial toxin	corn: 1	low	no	Valent BioSciences	corn, timothy
Dylox 420 LC	trichlorfon	organophosphorus	21	moderate	no	Bayer CropScience	barley, oat, wheat
Force 3 G	tefluthrin	pyrethroid	Planting time only.	moderate	no	Syngenta Crop Protection Canada	corn
Furadan 480 F	carbofuran	carbamate	canola: 60	high	yes for all crops listed	Bayer CropScience	canola, mustard Toxic to bees.
Imidan 50 WP	phosmet	organophosphorus	7	moderate	no	Gowan Company	alfalfa Toxic to bees.
Lagon 480 EC	dimethoate	organophosphorus	alfalfa: 2 canola: 21 cereal: 2 dry edible beans: 7 soybeans: 30	moderate	yes for all crops listed	United Agri Products Canada Inc.	alfalfa, canola, cereals, dry edible beans, soybeans Toxic to bees.
Lannate Toss-N-Go 90 SP	methomyl	carbamate	canola: 8 cereals: 20	high	yes for all crops listed	Dupont Canada	canola, cereals Toxic to bees.
Lorsban 4 E 15 G	chlorpyrifos	organophosphorus	canola: 21 corn: 70 wheat: 60	moderate	yes for all crops listed except corn	Dow AgroSciences	canola, cereals, corn Toxic to bees.
Malathion 500 EC	malathion	organophosphorus	alfalfa: 7 cereals: 7 corn: 7 dry edible beans: 3	low	no	United Agri Products Canada	alfalfa, cereals, corn, dry edible beans, soybeans Toxic to bees. Less effective below 20°C.

Table 9–3. Foliar Insecticides Used on Field Crops

TRADE NAME	Active ingredient	Insecticide Classification	Pre-Harvest Interval	Relative Toxicities	Aerial Application	Manufacturer	Use and Notes
Matador 120 EC	cyhalothrin-lambda	pyrethroid	canola: 7 field & seed corn: 21 silage corn: 14 dry edible beans: 14 soybeans: 21 wheat: 28	moderate	yes for all crops listed	Syngenta Crop Protection Canada	alfalfa, barley, canola, corn, dry edible beans, oat, soybeans, wheat
Oberon	spiromesifen	tetronic acids	field corn: 30 silage corn: 5	high	yes	Bayer CropScience	corn (field and silage)
Pounce EC	permethrin	pyrethroid	canola: 1	moderate	no	Bayer CropScience	canola, cereals, corn, flax, sunflowers
Pyrifos 15G	chlorpyrifos	organophosphorus	Planting time only.	moderate	no	United Agri Products Canada Inc.	corn Toxic to bees.
Pyrinex 480 EC	chlorpyrifos	organophosphorus	canola: 21 cereals: 60 corn: 70	moderate	yes for all crops listed except corn	United Agri Products Canada Inc.	canola, cereals, corn Toxic to bees.
Ripcord 400 EC	cypermethrin	pyrethroid	barley: 45 canola: 30 corn: 5 wheat: 30	moderate	yes for all crops listed except wheat, barley and canola	BASF Canada	canola, corn, wheat Toxic to bees.
Sevin XLR Plus	carbaryl	carbamate	alfalfa: 2 barley: 28 corn: 1 dry edible beans: 5 oat: 14 wheat: 14	moderate	yes for all crops listed except beans and canola	Bayer CropScience	alfalfa, canola, cereals, corn, dry edible beans Toxic to bees.
Silencer 120 EC	cyhalothrin-lambda	pyrethroid	barley: 28 canola: 7 corn: 14 dry edible beans: 14 oat: 28 soybeans: 21 wheat: 28	moderate	yes for all crops listed except soybeans and beans	Makhteshim Agan of North America	alfalfa, barley, canola, corn, dry edible beans, oat, soybeans, wheat
Thiodan 4 EC	endosulfan	organo-chlorine	alfalfa, rye: 30 beans: 2 corn: 50	moderate	no	Bayer CropScience	alfalfa, corn, dry edible beans, rye Toxic to bees.
Thionex EC	endosulfan	organo-chlorine	alfalfa: 30 corn: 50 dry edible beans: 2 rye: 30	moderate	no	United Agri Products Canada	alfalfa, corn, dry edible beans, rye Toxic to bees.
Thuricide HPC	*Bacillus thuringiensis*	bacterial toxin	0	low	yes	Valent Biosciences	timothy

Table 9–4. Transgenic Crops Expressing Insecticidal or Fungicidal Traits

TRADE NAME	Event	Cry Protein (delta endotoxin)	Trait Licensers	Pests Controlled	Remarks[1]
Agrisure CB/LL	Bt11	Cry1Ab	Syngenta Seeds Canada; Syngenta + Mycogen/Dow AgroSciences	European corn borer	Provides suppression of corn earworm and fall armyworm.
Agrisure GT/CB/LL	GA21 + Bt11	Cry1Ab	Syngenta Seeds Canada; Syngenta + Mycogen/Dow AgroSciences	European corn borer	Provides suppression of corn earworm and fall armyworm.
Agrisure RW	MIR604	mCry3A	Syngenta Seeds Canada; Syngenta + Mycogen/Dow AgroSciences	corn rootworm larvae	
Agrisure GT/RW	GA21 + MIR604	mCry3A	Syngenta Seeds Canada; Syngenta + Mycogen/Dow AgroSciences	corn rootworm larvae	
Agrisure CB/LL/RW	Bt11 + MIR604	Cry1Ab + mCry3A	Syngenta Seeds Canada; Syngenta + Mycogen/Dow AgroSciences	corn rootworm European corn borer	Provides suppression of corn earworm and fall armyworm.
Agrisure 3000GT	GA21 + Bt11 + MIR604	Cry1Ab + mCry3A	Syngenta Seeds Canada; Syngenta + Mycogen/Dow AgroSciences	corn rootworm European corn borer	Provides suppression of corn earworm and fall armyworm.
Agrisure Viptera 3110	GA21 + Bt11 + MIR162	Vip3A + Cry1Ab	Syngenta Seeds Canada; Syngenta + Mycogen/Dow AgroSciences	black cutworm corn earworm European corn borer fall armyworm western bean cutworm	
Agrisure Viptera 3111	GA21 + Bt11 + MIR162 + MIR604	Vip3A + Cry1Ab + mCry3A	Syngenta Seeds Canada; Syngenta + Mycogen/Dow AgroSciences	black cutworm corn earworm corn rootworm European corn borer fall armyworm western bean cutworm	
Herculex I	TC1507	Cry1F	Dow AgroSciences/ Pioneer Hi-Bred International	black cutworm* European corn borer fall armyworm western bean cutworm	* May only provide control of young larvae.
Herculex RW	DAS-59122-7	Cry34Ab1/ Cry35Ab1	Dow AgroSciences/ Pioneer Hi-Bred International	corn rootworm larvae	
Herculex XTRA	TC1507 + DAS-59122-7	Cry1F + Cry34Ab1/ Cry35Ab1	Dow AgroSciences/ Pioneer Hi-Bred International	black cutworm* corn rootworm European corn borer fall armyworm western bean cutworm	* May only provide control of young larvae.

[1] Insect resistance management strategies must be followed when planting Bt corn. See *A Grower's Handbook: Controlling Corn Insect Pests With Bt Corn Technology*, found at www.cornpest.ca, for more information.

Table 9–4. Transgenic Crops Expressing Insecticidal or Fungicidal Traits

TRADE NAME	Event	Cry Protein (delta endotoxin)	Trait Licensers	Pests Controlled	Remarks[1]
YieldGard CB (YGCB)	MON810	Cry1Ab	Monsanto Canada	European corn borer	Provides suppression of corn earworm and fall armyworm.
YieldGard CB (YGCB) w/RR2	MON 810 + NK 603	Cry1Ab	Monsanto Canada	European corn borer	Provides suppression of corn earworm and fall armyworm.
YieldGard Plus w/RR2	MON 810 + MON 863 + NK 603	Cry1Ab + Cry3Bb1	Monsanto Canada	corn rootworm larvae European corn borer	Provides suppression of corn earworm and fall armyworm.
YieldGard VT Rootworm/RR2	MON88017	Cry3Bb1	Monsanto Canada	corn rootworm larvae	
YieldGard VT Triple (VT3)	MON810 and MON88017	Cry1Ab + Cry3Bb1	Monsanto Canada	corn rootworm larvae European corn borer	Provides suppression of corn earworm and fall armyworm.
Genuity VT Double Pro (GENVT2P)	MON 89034 + NK 603	Cry1A.105 + Cry2Ab2	Monsanto Canada; Monsanto Canada + Mycogen/Dow AgroSciences	corn earworm European corn borer fall armyworm	
Genuity VT Triple Pro (GENVT3P)	MON 89034 + MON 88017	Cry1A.105 + Cry2Ab2 + Cry3Bb1	Monsanto Canada; Monsanto Canada + Mycogen/Dow AgroSciences	corn earworm corn rootworm European corn borer fall armyworm	
Genuity SmartStax (GENSS) (Monsanto) or SmartStax (Mycogen)	MON 88017 + MON 89034 + TC 1507 + DAS-59122-7	Cry1A.105 + Cry2Ab2 + Cry1F + Cry3Bb1 + Cry34Ab1/ Cry35Ab1	Monsanto Canada; Monsanto Canada + Mycogen/Dow AgroSciences	black cutworm* corn earworm corn rootworm European corn borer fall armyworm western bean cutworm	* May only provide control of young larvae.

[1] Insect resistance management strategies must be followed when planting Bt corn. See *A Grower's Handbook: Controlling Corn Insect Pests With Bt Corn Technology*, found at www.cornpest.ca, for more information.

Table 9–5. Re-Entry Intervals for Pesticides Used on Field Crops

Trade Name	Active Ingredient	Re-Entry Interval
Astound	cyprodinil + fludioxonil	12 hr
Caramba	metconazole	5 days in cereals
Concept	imidacloprid + deltamethrin	24 hr
Coragen	chlorantraniliprole	12 hr
Decis 5.0 EC	deltamethrin	12 hr
Delegate WG	spinetoram	12 hr
Dylox 420 LC	trichlorfon	24 hr
Folicur 250 EW	tebuconazole	12 hr
Folicur 432 F	tebuconazole	12 hr
Furadan 480 F	carbofuran	48 hr[1]
Headline EC	pyraclostrobin	12 hr
Imidan 50 WP	phosmet	5 days for alfalfa
Lance WDG	boscalid	4 hr
Lannate Toss-N-Go 90 SP	methomyl	24 hr
Lorsban 4 E 15 G	chlorpyrifos	24 hr
Matador 120 EC Silencer 120 EC	cyhalothrin-lambda	24 hr
Oregon	spiromesifen	12 hr
Pounce EC	permethrin	when dry
Proline 480 SC	prothioconazole	24 hr
Prosaro 250EC	prothioconazole + tebuconazole	12 hr
Pyrifos 15G Pyrinex 480 EC	chloropyrifos	24 hr
Quadris	azoxystrobin	when dry
Quilt	azoxystrobin + propiconazole	12 hr
Rovral WP	iprodione	12 hr
Stratego 250 EC	trifloxystrobin + propiconazole	12 hr
Thionex EC	endosulfan	48 hr

[1] If prolonged direct contact with corn foliage will occur, do not enter treated fields within 14 days of application without wearing protective equipment.

Table 9–6. Pesticides Used in Field Crops That Affect Cholinesterase Levels in Blood

Active Ingredient	Trade Name
carbaryl	Sevin XLR
carbofuran	Furadan 480 F
chlorpyrifos	Lorsban 4E Pyrinex 480 EC Pyrifos 15G
diazinon	Agrox B-2 Agrox CD
dimethoate	Cygon 480 Lagon 480
malathion	Malathion 500 EC
methomyl	Lannate Toss-N-Go
phosmet	Imidan 50 WP
phorate	Thimet 15G
terbufos	Counter

Table 9–7. Relative Toxicity of Insecticides to Honeybees

Trade Name	Active Ingredient
Group 1 – Very toxic. Do not apply to flowering crops or weeds.	
Concept	imidacloprid + deltamethrin
Cygon 480 Lagon 480	dimethoate
Furadan 480 F	carbofuran
Imidan 50 WP	phosmet
Lannate Toss-N-Go	methomyl
Lorsban 4E Pyrifos 15G Pyrinex 480 EC	chlorpyrifos
Malathion 500 EC	malathion
Ripcord 400EC	cypermethrin
Sevin XLR	carbaryl
Group 2 – Apply only during late evening or early morning.[1]	
Decis 5.0 EC	deltamethrin
Thiodan 4 EC Thionex EC	endosulfan

[1] Unusually low temperatures at time of application may cause insecticides to remain toxic up to 20 times longer than during warm weather. High temperatures in the early morning or late evening may extend active foraging by bees.

10. Appendices

Appendix A.

Manufacturers of Pesticides Recommended in Publication 812

BASF Canada Inc.
100 Milverton Dr., 5th Floor
Mississauga, ON L5R 4H1
Tel 1-866-485-BASF (2273)
Fax 289-360-6000
www.agsolutions.ca

Bayer CropScience
Suite 200, 160 Quarry Park Blvd. SE
Calgary, AB T2C 3G3
Tel 1-888-283-6847
Fax 403-723-7488
www.bayercropscience.ca

Chemtura
120 Huron St.
Guelph, ON N1E 5L7
Tel 1-800-423-8570
www.chemtura.com

Dow AgroSciences Solutions Centre
2100-450 1 St. SW
Calgary AB T2P 5H1
Tel 1-800-667-3852
Fax 1-888-296-6188
www.dowagro.ca

DuPont Canada Inc.
7070 Mississauga Rd., P.O. Box 2200
Streetsville, ON L5M 2H3
Tel 1-800-387-2122
Fax 905-821-5057
http://ca.dupont.com

Engage Agro Corp.
1030 Gordon St.
Guelph, ON N1G 4X5
Tel 519-826-7878
Fax 519-826-7675
www.engageagro.com

Gowan Company
370 Main St.
Yuma, AZ US 85364
Tel 1-800-883-1844, ext. 2
www.gowanco.com

Growmark Inc.
6789 Kitimat Rd.
Mississauga, ON L5N 1V2
Tel 905-826-5991
Fax 905-826-7701
www.growmark.com

Interprovincial Cooperative Ltd.
945 Marion St.
Winnipeg, MB R2J 0K7
Tel 204-233-3461
Fax 204-233-8462
www.ipco.ca

Makhteshim Agan of North America Inc.
4515 Falls of Neuse Rd., Ste. 300
Raleigh, NC US 27609
Tel 1-866-626-2462
www.manainc.com

Monsanto Canada
900 - One Research Road
Winnipeg, MB R3T 6E3
Tel 1-800-667-4944
Fax 1-888-556-5565
www.monsanto.ca

Norac Concepts Inc.
P.O. Box 31097
Guelph, ON N1H 8K1
Tel 519-821-3633
Fax 519-821-2083
www.noracconcepts.com

Plant Products Co. Ltd.
314 Orenda Road
Brampton, ON L6T 1G1
Tel 1-800-387-2449
Fax 905-793-9157
www.plantprod.com

Syngenta Crop Protection Canada Inc.
140 Research Lane
Guelph, ON N1G 4Z3
Tel 1-877-964-3682
Fax 1-877-214-5405
www.syngenta.ca

United Agri Products Canada Inc.
789 Donnybrook Dr.
Dorchester, ON N0L 1G5
Tel 1-800-265-4624
Fax 519-268-8013
www.uap.ca

Valent BioSciences Canada, Ltd.
130 Research Lane, Unit 6
Guelph, ON N1G 5G3
Tel 519-767-9262
Fax 925-817-5026
www.valent.ca

Appendix B.

Ontario Ministry of Agriculture, Food and Rural Affairs Field Crop Advisory Staff List by Location

Brighton Resource Centre 95 Dundas St. E, RR#3, Brighton, ON K0K 1H0		Tel Fax	613-475-1630 613-475-3835	
Guelph OMAFRA 1 Stone Rd. W., Guelph, ON N1G 4Y2				
Crop Protection Program Lead	Denise Beaton	Tel Fax	519-826-6594 519-826-4964	denise.beaton@ontario.ca
Minor Use Coordinator	Jim Chaput	Tel Fax	519-826-3539 519-826-4964	jim.chaput@ontario.ca
Organic Crop Production Program Lead	Hugh Martin	Tel Fax	519-826-4587 519-826-4964	hugh.martin@ontario.ca
Harrow Greenhouse and Processing Crops Research Centre, 2585 County Road 20, Harrow, ON N0R 1G0		Tel Fax	519-738-2251 519-738-4564	
Kemptville Resource Centre P.O. Box 2004, Concession Road, Kemptville, ON K0G 1J0		Tel Fax	613-258-8295 613-258-8392	
Emerging Crops Specialist	Scott Banks	Tel	613-258-8359	scott.banks@ontario.ca
Field Crops, IPM Program Lead – Bilingual	Gilles Quesnel	Tel	613-258-8250	gilles.quesnel@ontario.ca
Lindsay Resource Centre 322 Kent St. W, Lindsay, ON K9V 2Z9		Tel Fax	705-324-6125 705-324-1638	
Forage Specialist	Joel Bagg	Tel	705-324-5856	joel.bagg@ontario.ca
New Liskeard 280 Armstrong St., P.O. Box 4070, New Liskeard, ON P0J 1P0		Tel Fax	1-800-461-6132 705-647-7993	
Ridgetown Resource Centre Agronomy Building, Ridgetown College, P.O. Box 400, Main St. E, Ridgetown, ON N0P 2C0		Tel Fax	519-674-1690 519-674-1564	
Entomology, Field Crops Program Lead	Tracey Baute	Tel	519-674-1696	tracey.baute@ontario.ca
Pathologist – Field Crops Program Lead	Albert Tenuta	Tel	519-674-1617	albert.tenuta@ontario.ca
Soil Management Specialist – Field Crops	Adam Hayes	Tel	519-674-1621	adam.hayes@ontario.ca
Simcoe Resource Centre P.O. Box 587, Blueline Rd. & Hwy #3, Simcoe, ON N3Y 4N5		Tel Fax	519-426-7120 519-428-1142	
Application Technology Specialist	Jason Deveau	Tel	519-426-8934	jason.deveau@ontario.ca
Stratford Resource Centre 581 Huron St., Stratford, ON N5A 5T8		Tel Fax	519-271-0280 519-273-5278	
Canola & Edible Beans Specialist	Brian Hall	Tel	519-271-0083	brian.hall@ontario.ca
Cereals Specialist	Peter Johnson	Tel	519-271-8180	peter.johnson@ontario.ca
Soil Fertility Specialist	Vacant	Tel	519-271-9269	
Soybean Specialist	Horst Bohner	Tel	519-271-5858	horst.bohner@ontario.ca

Appendix B.

Ontario Ministry of Agriculture, Food and Rural Affairs Field Crop Advisory Staff List by Location

University of Guelph 50 Stone Rd. E., Guelph, ON N1G 2W1		Tel	519-824-4120	
Applied Research Coordinator – Field Crops Crop Science Building	Ian McDonald	Tel Fax	519-824-4120, ext. 56707 519-763-8933	ian.mcdonald@ontario.ca
Corn Industry Program Lead Crop Science Building	Greg Stewart	Tel Fax	519-824-4120, ext. 54865 519-763-8933	greg.stewart1@ontario.ca
Weed Management Field Crops Program Lead, Crop Science Building, Room 303	Mike Cowbrough	Tel Fax	519-824-4120, ext. 52580 519-763-8933	mike.cowbrough@ontario.ca
Vineland – University of Guelph 4890 Victoria Ave. N., P.O. Box 7000, Vineland Station, ON L0R 2E0		Tel Fax	905-562-4141 905-562-3413	
Vineland Resource Centre Adv. Serv. Building, P.O. Box 8000, 4890 Victoria Ave. N., Vineland Station, ON L0R 2E0		Tel Fax	905-562-4147 905-562-5933	
Woodstock Resource Centre P.O. Box 666, Hwy. #59 N, Woodstock, ON N4S 7Z5		Tel Fax	519-537-6621 519-539-5351	
Nutrient Management Field Crops Program Lead	Christine Brown	Tel	519-537-8305	christine.brown1@ontario.ca

Agricultural Information Contact Centre
Provides province-wide, toll-free technical and business information to commercial farms, agri-businesses and rural businesses.

1 Stone Rd. W.
Guelph, ON N1G 4Y2
Tel: 519-826-4047
Toll-free: 1-877-424-1300
Fax: 519-826-7610
E-mail: ag.info.omafra@ontario.ca

A complete list of Agriculture Development Branch staff can be found on the OMAFRA website at www.ontario.ca/crops.

Cropline
CropLine is a province-wide, toll-free, phone service on crop management tips, herbicide recommendations and pest alerts produced twice a week in season. The number to call is 1-888-449-0937. Leave a message for OMAFRA's field crop specialists, and they'll do their best to address it on the next CropLine. If you'd rather listen to the CropLine on your computer or MP3 player, you can subscribe to our new CropLine Podcast! Visit www.ontario.ca/cropline for more information.

Appendix C.
Ontario Ministry of the Environment Regional Contact Information

REGION County	Address	Telephone/Fax
CENTRAL REGION Toronto, Halton, Peel York, Durham, Muskoka, Simcoe	5775 Yonge St., 8th Floor Toronto, ON M2M 4J1	Tel 416-326-6700 Toll-free 1-800-810-8048 Fax 416-3256345
WEST-CENTRAL REGION Haldimand, Norfolk, Niagara, Hamilton-Wentworth, Dufferin, Wellington, Waterloo, Brant	Ontario Government Building 119 King St. West, 12th Floor Hamilton, ON L8P 4Y7	Tel 905-521-7640 Toll-free 1-800-668-4557 Fax 905-521-7820
EASTERN REGION Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville, Prescott & Russell, Stormont/Dundas & Glengarry, Haliburton, Peterborough, City of Kawartha Lakes, Northumberland, Renfrew, Ottawa, Lanark (Township of South Algonquin)	1259 Gardiners Rd., Unit 3 PO Box 22032 Kingston, ON K7M 8S5	Tel 613-549-4000 Toll-free 1-800-267-0974 Fax 613-548-6908
SOUTHWESTERN REGION Elgin, Middlesex, Oxford, Essex, Kent, Lambton, Bruce, Grey, Huron, Perth	733 Exeter Rd., 2nd Floor London, ON N6E 1L3	Tel 519-873-5000 Toll-free 1-800-265-7672 Fax 519-873-5020
NORTHERN REGION (EAST) Manitoulin, Nipissing, Parry Sound, Sudbury, Algoma (East), Timiskaming, Sault Ste. Marie	199 Larch St., Suite 1201 Sudbury, ON P3E 5P9	Tel 705-564-3237 Toll-free 1-800-890-8516 Fax 705-564-4180
NORTHERN REGION (WEST) Algoma (West), Cochrane, Kenora, Rainy River, Timmins, Thunder Bay	435 James St. S., Suite 331, 3rd Floor Thunder Bay, ON P7E 6S7	Tel 807-475-1205 Toll-free 1-800-875-7772 Fax 705-475-1754
Standards Development Branch	Pesticides Section 40 St. Clair Ave. W., 7th Floor Toronto, ON M4V 1M2	Tel 416-327-5519 Fax 416-327-2936
Approvals Branch	Pesticides Licensing 2 St. Clair Ave. W., 12A Floor Toronto, ON M4V 1L5	Tel 416-314-8001 Toll-free 1-800-461-6290 Fax 416-314-8452

Appendix D.
Other Contacts

AGRICULTURE & AGRI-FOOD CANADA RESEARCH CENTRES
http://www.agr.gc.ca/index_e.php

Eastern Cereals and Oilseeds Research Centre
960 Carling Ave.
Ottawa, K1A 0C6
Tel 613-759-1858

Greenhouse and Processing Crops Centre
2585 County Road 20
Harrow N0R 1G0
Tel 519-738-2251

Southern Crop Protection and Food Research Centre
http://res2.agr.ca/london/pmrc/index_e.htm

1391 Sandford St.
London N5V 4T3
Tel 519-457-1470

Vineland Research Farm
4902 Victoria Ave. N.
Vineland L0R 2E0
Tel 905-562-4113

Delhi Research Farm
Box 186 Schafer Rd.
Delhi N4B 2W9
Tel 519-582-1950

UNIVERSITY OF GUELPH

Main Campus
Guelph, N1G 2W1
Tel 519-824-4120
www.uoguelph.ca

Alfred Campus
Alfred, K0B 1A0
Tel 613-679-2218
www.alfredc.uoguelph.ca

Kemptville Campus
Kemptville, K0G 1J0
Tel 613-258-8336
www.kemptvillec.uoguelph.ca

Ridgetown Campus
Ridgetown, N0P 2C0
Tel 519-674-1500
www.ridgetownc.on.ca

Department of Plant Agriculture
www.plant.uoguelph.ca

Department of Plant Agriculture, Guelph
50 Stone Rd. E.
Guelph, ON N1G 2W1
Tel 519-824-4120, ext. 56083 or 52693

Department of Plant Agriculture, Simcoe
1283 Blueline Rd., Box 587
Simcoe, N3Y 4N5
Tel 519-426-7127

Department of Plant Agriculture, Vineland
Box 7000, 4890 Victoria Ave. N.
Vineland Station, L0R 2E0
Tel 905-562-4141

Lab Services Division
www.uoguelph.ca/labserv/

95 Stone Rd. W.
Guelph, N1H 8J7

Trace Organic and Pesticide Contaminants
Tel 519-823-1268

Pest Diagnostic Clinic
Tel 519-767-6256

Appendix E.
Diagnostic Service

Samples for disease diagnosis, insect or weed identification, nematode counts and *Verticillium* testing can be sent to:

University of Guelph
Laboratory Services Division
Pest Diagnostic Clinic
95 Stone Road West
Guelph, ON N1H 8J7

Tel 519-767-6299
Fax 519-767-6240
E-mail aflinfo@uoguelph.ca

www.guelphlabservices.com

Payment must accompany samples at the time of submission. Submission forms are available at: www.guelphlabservices.com/AFL/submit_samples.aspx.

How to Sample for Nematodes

Soil

When to sample

Soil and root samples can be taken at any time of the year that the soil is not frozen. In Ontario, nematode soil population levels are generally at their highest in May and June and again in September and October.

How to sample soil

Use a soil sampling tube, trowel or narrow-bladed shovel to take samples. Sample soil to a depth of 20–25 cm (8–10 in.). If the soil is bare, remove the top 2 cm (1 in.) prior to sampling. A sample should consist of 10 or more subsamples combined. Mix well. Then take a sample of 0.5–1 L (1 pint–1 quart) from this. No single sample should represent more than 2.5 ha (6.25 acres). Mix subsamples in a clean pail or plastic bag.

Sampling pattern

If living crop plants are present in the sample area, take samples within the row and from the area of the feeder root zone (with trees, this is the drip line).

Number of subsamples

Based on the total area sampled:

500 m^2 (5,400 ft^2)	10 subsamples
500 m^2–0.5 ha (5,400 ft^2–1.25 acres)	25 subsamples
0.5 ha–2.5 ha (1.25–6.25 acres)	50 subsamples

Roots

For small plants, sample the entire root system plus adhering soil. For large plants, 10–20 g (½–1 oz.), dig fresh weight from the feeder root zone and submit.

Problem areas

Take soil and root samples from the margins of the problem area where the plants are still living. If possible, also take samples from healthy areas in the same field. If possible, take both soil and root samples from problem and healthy areas in the same field.

Sample Handling

Soil samples

Place in plastic bags as soon as possible after collecting.

Root samples

Place in plastic bags and cover with moist soil from the sample area.

Storage

Store samples at 5°C–10°C and do not expose them to direct sunlight or extreme heat or cold (freezing). Only living nematodes can be counted. Accurate counts depend on proper handling of samples.

Submitting Plant for Disease Diagnosis or Identification

Sample submission forms

Forms can be obtained from your local Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) office. Carefully fill in all of the categories on the form. In the space provided, draw the most obvious symptom and the pattern of the disease in the field. It is important to include the cropping history of the area for the past 3 years and pesticide use records from this year.

Choose a complete, representative sample showing early symptoms. Submit as much of the plant as is practical, including the root system, or several plants showing a range of symptoms. If symptoms are general, collect the sample from an area where they are of intermediate severity. Completely dead material is usually inadequate for diagnosis.

With plant specimens submitted for identification, include at least a 20–25-cm sample of the top portion of the stem with lateral buds, leaves, flowers or fruits in identifiable condition. Wrap plants in newspaper and put in a plastic bag. Tie the root system off in a separate plastic bag to avoid the soil drying out and contaminating the leaves. Do not add moisture, as this encourages decay in transit. Cushion specimens and pack in a sturdy box to avoid damage during shipping. Avoid leaving specimens to bake or freeze in a vehicle or in a location where they could deteriorate.

Delivery

Deliver to the Pest Diagnostic Clinic as soon as possible by first class mail or courier at the beginning of the week.

Submitting Insect Specimens for Identification

Collecting samples

Place dead, hard-bodied insects in vials or boxes and cushion with tissues or cotton. Place soft-bodied insects and caterpillars in vials containing alcohol. Do not use water, as this results in rot. Do not tape insects to paper or send them loose in an envelope.

Place live insects in a container with enough plant "food" to support them during transit. Be sure to write "live" on the outside of the container.

UNIVERSITY of GUELPH
LABORATORY SERVICES

Sample Submission Form

95 Stone Road West
Guelph, ON N1H 8J7
Tel: (519) 824-4120 ext. 57256
Fax: (519) 767-6240
Web: www.guelphlabservices.com

LABORATORY USE ONLY: LS Form: SubP07/03/27 Pg. 1 of 1

Rec'd: By:_____ **Date Received:** _____

Delivered By: ☐ **Mail** ☐ **Courier** ☐ **In-Person**

LS Sample No: _____ **to** _____

Payment Rec'd: $_____ **Receipt #:**_____

Pest Diagnostic Clinic

Submitted By:			Owner (if different from submitter):		
Business Name (if applicable):			Business Name (if applicable):		
Street:			Street:		
City:	Prov:	Postal Code:	City:	Prov:	Postal Code:
Tel: ( ) -	Fax: ( ) -		Tel: ( ) -	Fax: ( ) -	
Email:			Email:		

Unless otherwise indicated, report and invoice will be sent to submitter

Report to: ☐ Submitter ☐ Owner Required Report Format: ☐ Fax ☐ E-Mail ☐ Mail

Invoice to: ☐ Submitter ☐ Owner Quotation #: _____ Purchase Order / U of G G/L code:_____

Services Required: ☐ Nematode Count ☐ Nematode Count from Roots ☐ SCN Cyst & Egg Count
☐ Plant Disease Diagnosis ☐ Insect Identification ☐ Plant Identification ☐ DNA Multiscan

If submitting a water sample, please answer the following question:
Is the purpose of the water test request to assess the quality of water for human consumption? ☐ **YES** ☐ **NO**
Date:_____ **Signature:**_____

Plant or Host Affected:		Cultivar/Variety:	Grower/Field sample #:
		Location of Plant (i.e. greenhouse, field, orchard, garden, etc.):	
Size of Planting:	% of Plants Affected:	Symptoms First Appeared in Past: ☐ Days ☐ Weeks ☐ Months ☐ Years	Degree of Injury: ☐ Severe ☐ Moderate ☐ Light
Cropping History:		Future Crop:	

Describe the problem in detail (i.e. symptoms, plant parts affected, distribution of symptoms):

Were chemicals applied? Please specify type of product(s) used and date(s) of application:

Additional comments and specific requests:

Appendix F.
Pesticide Groups Based on Sites of Action

Group #	Primary Site of Action	Group Name	Product name(s)	Risk of Developing Resistance
		Insecticides		
	The classification scheme listed below is adapted from the Insecticide Action Committee Mode of Action Classification (IRAC) V7, September 2010.			
1A[1]		carbamate	Furadan 480 F, Lannate, Pirimor 50 DF, Sevin XLR, Vydate L	High
1B	Acetylcholine esterase inhibitors	organophosphate	Agrox B-2, Agrox CD, Counter 15 G, Cygon 480, Imidan 50 WP, Lagon 480, Lorsban 4E, Lorsban 15 G, Malathion 500 E, Monitor 480, Pyrifos 15 G, Pyrifos 50 W, Pyrinex 480 EC, Thimet 15 G	High
2A	GABA-gated chloride channel agonists	chlorinated cyclodiene	Thiodan 4 EC, Thiodan 50 WP, Thionex 50 W	Mod
3A	Sodium channel modulators	pyrethroid	Concept, Decis 5 EC, Force 3.0 G, Matador 120 EC, Pounce 384 EC, Ripcord 400 EC, Silencer 120EC	High
4A	Nicotinic acetylcholine receptor agonists	neonicotinoids	Admire, Gaucho 480 FL, Concept, Gaucho GS, Poncho 600, Cruiser 5FS, Cruiser 350FS, Helix Xtra, Prosper	Low to Moderate
5	Nicotinic acetylcholine receptor agonists (allosteric, not group 4)	naturalyte/spinosyns	Success 480 SC, Delegate	Low
9B	Selective homopteran feeding blockers	pyridines	Fulfill 50 WG	Low
11	Microbial disruptors of insect midgut membranes	biologicals	Bioprotec CAF, Dipex 2X DF, Novodor, Thurcide HPS	Low
17	Molting disrupters (Diperta only)	cyromazine	Citation 75 WP, Governor 75 WP	Low
21	Mitochondrial complex I electron transport inhibitor	botanicals	Rotenone 5, Rotenone 1% WP, Rotenone 5% WP	Low
23	Inhibitors of acetyl CoA carboxylase	tetronic and tetramic acid derivatives	Movento	
24	Mitochondrial complex IV electron transport inhibitors	inorganics (aluminum phosphide)	Fumitoxin, Phostoxin, Gastoxin	Moderate
28	Ryanodine receptor modulators	diamides	Coragen	Low to Moderate

[1] Although sharing the same primary target site, it is possible that not all members of a single major mode of action (MoA) class have been shown to be cross-resistant. However, for the purposes of this classification system, it should be assumed that cross-resistance exists between compounds in any one sub-group.

Appendix F.
Pesticide Groups Based on Sites of Action

Group #	Primary Site of Action	Group Name	Product name(s)	Risk of Developing Resistance
		Fungicides		
		This classification scheme is based on the Fungicide Resistance Action Committee (FRAC) List, 2010		
1	Inhibition of mitosis (turbulin formation)	methyl-benzimidazole carbamates	DCT, Senator 70 WP	High
2	Affect cell division, DNA & RNA synthesis & metabolism	dicarboximide	Ronilan EG, Rovral WP	Moderate to High
3	DMI (demethylation inhibitor): inhibition of sterol synthesis	triazole	Baytan 30, Bumper 418 EC, Caramba, Dividend XL RTA, Folicur 250 EW, Folicur 432F, Gemini, Proline 480 SC, Prosaro 250 EC, Quilt, Stratego 250 EC, Tilt 250 E, Rancona Apex, Raxil T, Raxil MD, Topas 250 E, Helix Xtra, Vortex FL	Moderate
4	Phenylamides affect RNA synthesis	acylamine (phenylamides)	Allegiance FL, Apron FL, Apron XL LS, Apron Maxx, Helix Xtra, Prosper, Raxil MD	High
5	Inhibition of an isomerase in sterol biosynthesis	morpholines	Acrobat MZ	Low to Moderate
7	Fungal respiration	carboxamide anilide	Anchor, Lance WDG, Vitaflo 280, Vitavax RS, Gaucho CS, Prosper	Moderate
9	Amino acid and protein synthesis	aniline-pyrimidines	Astound	Moderate
11	Fungal respiration: quinone outside inhibitors (QOI)	strobilurin	Cabrio EG, Dynasty 100, Headline EC, Quadris, Quilt, Stratego 250EC, Reason 500 SC, Tanos 50 DF, Trilex FS	High
12	Osmotic signal transduction	phenylpyrroles	Maxim 480 FS, Apron Maxx, Helix Xtra, Astound	Low to Moderate
14	Lipid peroxidation (proposed)	aromatic hydrocarbon chlorophenyl	Botran 75 W, Quintozene 75 WP	Low to Moderate
22	Mitosis and cell division	benzamide	Gavel 75 DF	Low to Moderate
25	Protein synthesis	antibiotic	Streptomycin	High
27	Unknown	cyanoacetamide oxime (acetamide)	Curzate 60 DF	Low to Moderate
28	Cell membrane permeability (proposed)	carbamate	Tatoo C	Low to Moderate
29	Uncouplers of oxidative phosphorylation	2,6-dinitro-anilines	Allegro	Low
33	Unknown	phosphonate	Aliette WDG	Low
44	Microbial disrupters of pathogen cell membranes	microbial	Contrans, Serenade ASO	Low
M1	Multi-site, contact	inorganic	Copper Spray, Copper 53 W, Kocide 101 WP, Kocide DF, Microscopic Sulphur, Oxidate, Parasol WP	Low
M3	Multi-site, contact	dithiocarbamate	Anchor, Acrobat MZ, Dithane, Dithane F 45, Ferbam 76 WDG, Gavel 75 DF, Manzate DF, Penncozeb 80, Polyram DF, Ridomil Gold, Thiram 75 WP, Vitaflo 280, Vitavax RS, Zineb 80 W, Gaucho CS, Prosper, Gemini	Low
M4	Multi-site, contact	phthalimide	Agrox B-2, Agrox CD, Captan, DCT, Maestro 75 DF, Supra Captan 80 WDG	Low
M5	Multi-site, contact	chloronitrile	Bravo 500, Tatoo C	Low

Appendix G.
The Metric System

Metric Units		
Linear Measures (length)		
10 millimetres (mm)	=	1 centimetre (cm)
100 centimetres (cm)	=	1 metre (m)
1,000 metres	=	1 kilometre (km)
Square Measures (area)		
100 m x 100 m = 10,000 m^2	=	1 hectare (ha)
100 ha	=	1 square kilometre (km^2)
Cubic Measures (volume)		
Dry Measure		
1,000 cubic millimetres (mm^3)	=	1 cubic centimetre (cm^3)
1,000,000 cm^3	=	1 cubic metre (m^3)
Liquid Measure		
1,000 millilitres (mL)	=	1 litre (L)
100 L	=	1 hectolitre (hL)
Weight-Volume Equivalents (for water)		
(1.00 kg) 1,000 grams	=	1 litre (1.00 L)
(0.50 kg) 500 g	=	500 mL (0.50 L)
(0.10 kg) 100 g	=	100 mL (0.10 L)
(0.01 kg) 10 g	=	10 mL (0.01 L)
(0.001 kg) 1 g	=	1 mL (0.001 L)
Weight Measures		
1,000 milligrams (mg)	=	1 gram (g)
1,000 g	=	1 kilogram (kg)
1,000 kg	=	1 tonne (t)
1 mg/kg	=	1 part per million (ppm)
Dry–Liquid Equivalents		
1 cm^3	=	1 mL
1 m^3	=	1,000 L

Application Rate Conversions		
Metric to Imperial (Approximate)		
litres per hectare x 0.09	=	gallons per acre
litres per hectare x 0.36	=	quarts per acre
litres per hectare x 0.71	=	pints per acre
millilitres per hectare x 0.015	=	fluid ounces per acre
grams per hectare x 0.015	=	ounces per acre
kilograms per hectare x 0.89	=	pounds per acre
tonnes per hectare x 0.45	=	tons per acre
Imperial to Metric (Approximate)		
gallons per acre x 11.23	=	litres per hectare (L/ha)
quarts per acre x 2.8	=	litres per hectare (L/ha)
pints per acre x 1.4	=	litres per hectare (L/ha)
fluid ounces per acre x 70	=	millilitres per hectare (mL/ha)
tons per acre x 2.24	=	tonnes per hectare (t/ha)
pounds per acre x 1.12	=	kilograms per hectare (kg/ha)
ounces per acre x 70	=	grams per hectare (g/ha)
Liquid Equivalents		
Litres/Hectare	=	***Approximate Gallons/Acre***
50	=	5
100	=	10
150	=	15
200	=	20
250	=	25
300	=	30

Dry Weight Equivalents		
Grams/Hectare	=	***Ounces/Acre***
100	=	1½
200	=	3
300	=	4¼
500	=	7
700	=	10
Kilograms/Hectare	=	***Pounds/Acre***
1.10	=	1
1.50	=	1¼
2.00	=	1¾
2.50	=	2¼
3.25	=	3
4.00	=	3½
5.00	=	4½
6.00	=	5¼
7.50	=	6¾
9.00	=	8
11.00	=	10
13.00	=	11½
15.0		13½
Metric Conversions		
5 mL	=	1 tsp
15 mL	=	1 tbsp
28.5 mL	=	1 fl. oz

Conversion Tables: Metric to Imperial		
Length		
1 millimetre (mm)	=	0.04 inch
1 centimetre (cm)	=	0.40 inch
1 metre (m)	=	39.40 inches
1 metre (m)	=	3.28 feet
1 metre (m)	=	1.09 yards
1 kilometre (km)	=	0.62 mile
Area		
1 square centimetre (cm^2)	=	0.16 square inch
1 square metre (m^2)	=	10.77 square feet
1 square metre (m^2)	=	1.20 square yards
1 square kilometre (km^2)	=	0.39 square mile
1 hectare (ha)	=	107,636 square feet
1 hectare (ha)	=	2.5 acres
Volume (dry)		
1 cubic centimetre (cm^3)	=	0.061 cubic inch
1 cubic metre (m^3)	=	1.31 cubic yards
1 cubic metre (m^3)	=	35.31 cubic feet
1,000 cubic metres (m^3)	=	0.81 acre-foot
1 hectolitre (hL)	=	2.8 bushels
Volume (liquid)		
1 millilitre (mL)	=	0.035 fluid ounce
1 litre (L)	=	1.76 pints
1 litre (L)	=	0.88 quart
1 litre (L)	=	0.22 gallon (Imp.)
1 litre (L)	=	0.26 gallon (U.S.)
Weight		
1 gram (g)	=	0.035 ounce
1 kilogram (kg)	=	2.21 pounds
1 tonne (t)	=	1.10 short tons
1 tonne (t)	=	2,205 pounds
Pressure		
1 kilopascal (kPa)	=	0.15 pounds/in^2
Speed		
1 metre per second	=	3.28 feet per second
1 metre per second	=	2.24 miles per hour
1 kilometre per hour	=	0.62 mile per hour
Temperature		
°F	=	(°C X ⅘) + 32

Conversion Tables: Imperial to Metric		
Length		
1 inch	=	2.54 cm
1 foot	=	0.30 m
1 yard	=	0.91 m
1 mile	=	1.61 km
Area		
1 square foot	=	0.09 m^2
1 square yard	=	0.84 m^2
1 acre	=	0.40 ha
Volume (dry)		
1 cubic yard	=	0.76 m^3
1 bushel	=	36.37 L
Volume (liquid)		
1 fluid ounce (Imp.)	=	28.41 mL
1 pint (Imp.)	=	0.57 L
1 gallon (Imp.)	=	4.55 L
1 gallon (U.S.)	=	3.79 L
Weight		
1 ounce	=	28.35 g
1 pound	=	453.6 g
1 ton	=	0.91 tonne
Pressure		
1 pound/square inch	=	6.90 kPa
Temperature		
°C	=	(°F 32) x ⅝

Abbreviations					
%	=	per cent (by weight)	km	=	kilometre
ai	=	active ingredient	km/h	=	kilometres per hour
AP	=	agricultural powder	kPa	=	kilopascal
cm	=	centimetre	L	=	litre
cm^2	=	square centimetre	m	=	metre
DG	=	dispersible granular	m^2	=	square metre
DP	=	dispersible powder	mL	=	millilitre
E	=	emulsifiable	mm	=	millimetre
e.g.	=	for example	m/s	=	metres per second
EC	=	emulsifiable concentrate	SC	=	sprayable concentrate
F	=	flowable	SP	=	soluble powder
g	=	gram	t	=	tonne
Gr	=	granules, granular	W	=	wettable (powder)
ha	=	hectare	WDG	=	water dispersible granular
kg	=	kilogram	WP	=	wettable powder

Appendix H.
Field Record Form

YEAR _____

	Field I.D.				Field I.D.				Field I.D.				Field I.D.			
Acreage																
Soil Type																
Soil Fertility	**pH**	**N**	**P**	**K**	**pH**	**N**	**P**	**K**	**pH**	**N**	**P**	**K**	**pH**	**N**	**P**	**K**
Tillage																
Variety/Hybrid																
Seeding Rate																
Seeding Date																
Seed Treatment																
Fertilizer/Lime product, rate, timing																
Manure Application																
Herbicides																
Rate																
Crop Stage																
Date																
Yield																
Harvest Date																
Moisture																
Test Wt/Grade																
Notes																

A PDF of this form can be found on the OMAFRA website at www.ontario.ca/crops (click on Publications, then Publication 812).

Appendix I.
Field Scouting Report

Farm: _____ **Scout:** _____ **Date:** _____ **Time:** _____

Field: _____ **Acreage:** _____ **Crop:** _____ **Plant Population:** ____

Crop Growth Stage, Height and Condition: _____

_____

_____

_____

Soil Condition: _____

Weeds	Growth Stage	Pressure/Density

Insects	Stage	Pressure/ Density

Diseases	Stage	Pressure/ Density

Field Map: weed, insect, disease patches, crop condition, including GPS coordinates

Field Scout's Comments: _____

_____

_____

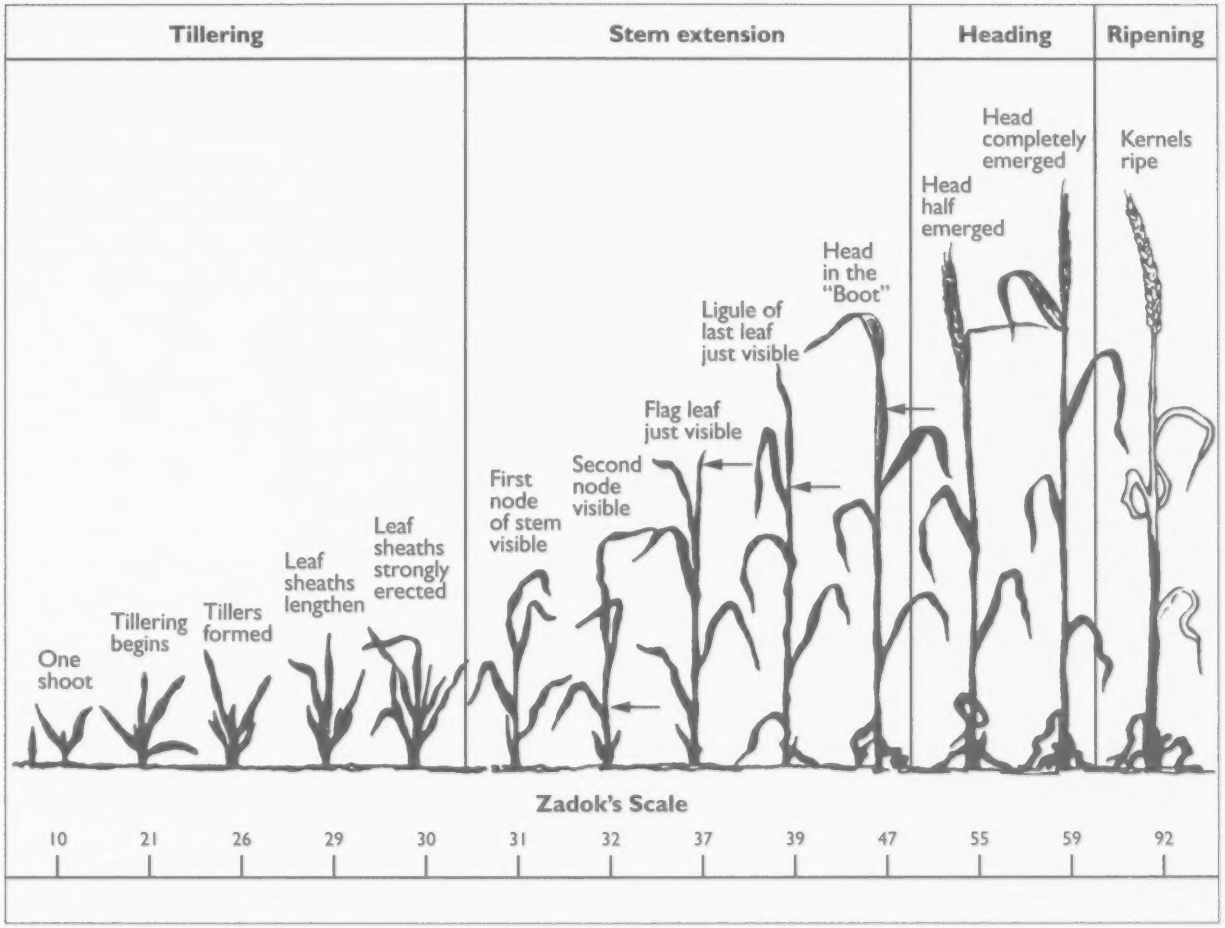
_____

Action Recommended: _____

_____

_____

Appendix J.
Cereal Growth Stages



Emergency and First-Aid Procedures for Pesticide Poisoning

For a major spill, a theft or a fire involving a pesticide call the Ministry of the Environment at **1-800-268-6060.**

For pesticide poisonings and pesticide injuries call the Poison Information Centre:
Toronto 1-800-268-9017
1-877-750-2233 (TTY)

PREVENT ACCIDENTS

- **Read the label.** Follow all the precautions the label recommends. Read the First Aid section of the label BEFORE you begin to handle any pesticide.
- **Make sure that someone knows** what pesticides you are working with and where you are.
- **Keep a file of labels and product Material Safety Data Sheets (MSDS) for the pesticides you use.**
  Make sure everyone knows where to find this in case of an emergency.
- **Post emergency numbers near all telephones.**
- **Keep clean water, paper towels, extra gloves and clean coveralls close by** in case you spill pesticide on yourself.

If someone has been working with pesticides and you see any possible symptoms of pesticide poisoning or injury, take emergency action immediately.

IF AN ACCIDENT OR POISONING HAPPENS

- Protect yourself from injury first.
- Stop the exposure to the pesticide. Move the victim away from the contaminated area.
- Check the four basic facts — identify the pesticide, the quantity, the route of entry and time of exposure.
- Call an ambulance or the Poison Information Centre.
- Start first aid. This is not a substitute for professional medical help.
- **Provide the label, MSDS sheet or container to emergency personnel** at the scene — or take it with you to the hospital. Do not transport pesticide containers in the passenger compartment of the vehicle.

FIRST AID

If a pesticide comes in contact with skin:

- remove all contaminated clothing; wash skin thoroughly with lots of soap and warm water
- dry skin well and cover with clean clothing or other clean material.

If pesticide comes in contact with eyes:

- hold eyelids open; wash the eyes with clean running water for 15 minutes or more.

If pesticide was inhaled:

- move the victim to fresh air and loosen tight clothing
- give artificial respiration if the victim is not breathing.

Do not breathe in the exhaled air from the victim — you could also be poisoned.

If a pesticide was swallowed:

- **call the Poison Information Centre IMMEDIATELY.**

Emergency numbers are listed at the front of each Bell telephone directory.

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- online at www.serviceontario.ca/publications
- by phone through the ServiceOntario Contact Centre, Monday to Friday, 8:30 AM to 5:00 PM ET
  - 416-326-5300
  - 1-800-668-9938, toll-free across Canada
  - 1-800-268-7095 (TTY), toll-free across Ontario
- in person at ServiceOntario Centres across Ontario

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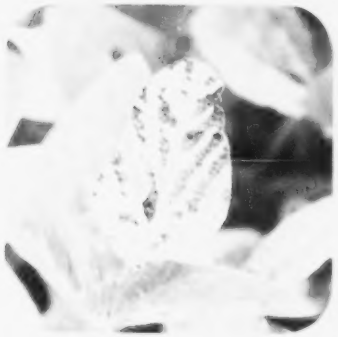

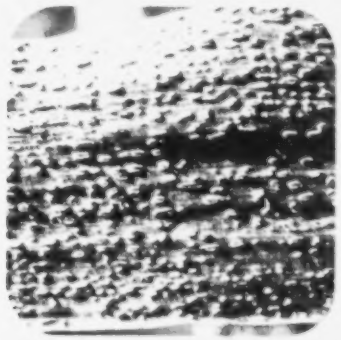

www.ontario.ca/crops